UNCTAD/ITP/TEC/29

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

Technological change in services and international trade competitiveness

UNITED NATIONS

Distr.
GENERAL

UNCTAD/ITP/TEC/29

12 July 1991

ENGLISH, FRENCH
AND SPANISH ONLY

Technological change in services and international trade competitiveness

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in co-operation with the UNCTAD secretariat

GE.91-55775

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LIST OF ACRONYMS

ASCII	American Standard Code for Information Interchange
ATM	Automated teller machines
CAD	Computer-aided design
CADD	Computer-aided design and drafting
CAM	Computer-aided manufacturing
CASE	Computer-aided software engineering
CD	Compact disc
CD-ROM	Compact disc - read only memory
CIM	Computer-integrated manufacturing
CT2	Cordless telephony 2
DBS	Direct broadcast satellite
DEC	Digital Equipment Corporation
DIE	Deindustrializing economy
EDI	Electronic data interchange
EPOS	Electronic point of sale
FDI	Foreign direct investment
IPR	Intellectual property rights
IPSE	Integrated programming support environments
ISDN	Integrated services digital networks
ISIC	International standard industrial classification
IT	Information technology
LAN	Local area networks
MDNS	Managed data network services
MIS	Management information systems
NIE	New industrial economy or neoindustrial economy
OA	Office automation
OSS	Optical switching systems
PBX	Private branch exchanges
PC	Personal computer
PIE	Postindustrial economy
PTO	Posts and telecommunications organizations or public telephone operators
R and D	Research and development
RISC	Reduced instruction set chips
SE	Software engineering
TNC	Transnational corporations
VANS	Value added network services
WIMP	Window/icon/mouse/pull-down menu
WP	Word processor
4GL	Fourth generation languages

PREFACE

(i) The Final Act of UNCTAD VII, in subparagraph (ii) of paragraph 105 (19), requested the Secretary-General of UNCTAD "to explore appropriate problematics for trade in services, keeping in view the technological changes in the field of services."

(ii) The technology dimension of trade has also received attention in the deliberations of the Trade and Development Board. In its resolution 380 (XXXVI), paragraph 4, the Board urged "Governments to take measures to assist technologically weak countries, especially developing countries, to fully participate in technology-led growth in international trade" and affirmed "the need for pursuing policies in the areas of technology which further the goal of trade expansion for the benefit of all trading partners, particularly developing countries, and which promote investment, innovation, absorption, utilization and development of technological and entrepreneurial capabilities".

(iii) Likewise, in its resolution 31 (VI), paragraph 2, the Committee on Transfer of Technology noted "with appreciation the preliminary studies on the impact of new and emerging technologies on trade and development" and urged "the UNCTAD secretariat to continue such studies and ensure a wider dissemination of the studies and to seek the views of Governments." In its resolution 32 (VII), paragraph 3, the same Committee recommended "that the UNCTAD secretariat continue to give increased and systematic attention to the trade and development opportunities and implications of new and emerging technologies ... and to identify possible options available to developing countries to benefit from these technologies...".

(iv) The present study has been prepared in response to these requests and resolutions, and forms part of a programme of research undertaken by the UNCTAD secretariat on the trade and development implications of new and emerging technologies. It is based on material prepared at the request of the UNCTAD secretariat by Ian Miles of the Science Policy Research Unit, University of Sussex, and by Sally Wyatt of Brighton Business School, Brighton Polytechnic. The views expressed in this study are those of the authors and do not necessarily represent those of the UNCTAD secretariat.

(v) The study is intended to complement other studies in this area prepared by the UNCTAD secretariat. While the previous studies have focused on the implications of new and emerging technologies for trade in commodities and manufactures, this one covers the implications of information technology for trade in services. Chapter I explores the nature of the information technology revolution, together with the concept of a new techno-economic paradigm. Chapter II discusses the links between services and other sectors and reviews different approaches to the classification of services. Chapter III examines technological change in different service industries and its implications for technology transfer and trade. Finally, chapter IV draws some conclusions and proposes an agenda for future research.

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INTRODUCTION

1. The world economy has been undergoing profound changes over the last decade. Two associated developments, in particular, have had considerable impact on the role of service sector activities in economic development. The first of these developments is the continuing internationalization of economic activities. Complex new international divisions of labour are continuing to emerge. As transnational firms extend their global reach, there is an expansion of such firms specializing in service activities -- in some cases as inputs to final consumption of national enterprises, sometimes as providers of global support to transnational corporations in other sectors.

2. The second set of developments involves the emergence of new styles of production and organization, and the technological revolution based on new information technology (IT). IT has particular implications for the service sectors which, in many ways, have the most scope to be transformed through the use of new technology. Previously, with few exceptions (e.g. transport, telecommunications), services' use of technology lagged well behind that of other sectors. Now services are major users of IT -- accounting for up to 80 per cent of investment in IT hardware in countries such as the United Kingdom and the United States -- and are accordingly changing their levels of capital-intensity, and the structure of this capital. This has led several commentators to suggest that many services are now in the early stages of a revolution as profound as the industrial revolution was for manufacturing sectors.

3. Combining these two main sets of developments implies examining a number of basic points. First, the role of services in economic development at a national and global level has been increasingly recognized. This is reflected in research and in national and international policy debates which display a shift away from the rather arid counterposing of "deindustrialization" and "post-industrial society" arguments, and toward more substantial analysis of the interconnections between services and other sectors of the economy. Rather than viewing services simply as a drain upon the manufacturing industry, or as an alternative source of jobs and exports, it would be useful to examine the linkages among services and between services and other activities. These linkages go well beyond the transactions recorded in input-output tables.[1] Services' roles may include, for example: being sources of demand for products; forming stimuli for innovation in user or supplier firms; competing for skills and other technical resources.

4. Secondly, services are liable to be increasingly important users of technology. Likewise, effective use of technologies will be an increasingly important determinant of the performance of services. Services thus impact heavily upon patterns of new technology production, and related topics such as the development of standards, skills, and technical competences. In turn, the suppliers of technologies can become major contributors to the innovativeness, competitiveness and economic performance of services.

5. Thirdly, with the growing technology-intensity of services, the internationalization of service firms and the expansion in certain areas of service trade, the role of services as potential agents of technology transfer requires attention. So far, surprisingly little analysis has been devoted to this topic. Yet it is well known that service trade often involves a physical presence, and that producer-consumer relations are often particularly close in services. There is thus considerable scope for exchange of information and experience in service transactions. The role of foreign service firms in host countries would therefore merit attention.

6. Fourthly, the role of services not only concerns users of technology, but also involves:

- Innovative actors, especially in the case of such "soft" technologies as computer software and new telematics services -- particularly since specialized IT service firms often become "systems integrators" responsible for putting together hardware and software packages to meet applications' requirements;

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1 Cf. Matthews and Miles (1989), Roach (1992).

- Catalysts for change, such as consultancies, engineering and design services, training services, etc.

7. Furthermore, heavy IT-using services are themselves important sources of IT innovations. In the past, services could often be dismissed as technologically unsophisticated users of innovations stemming from the manufacturing sector. Now, not only specialized IT services (e.g., software, telecommunications) but also advanced IT-using sectors (such as banking and air transport) are themselves the source of software and service product innovations. They may also exert pressure upon hardware manufacturers to develop particular types of interface or other equipment. Advanced users, too, may provide design suggestions to hardware firms -- for example, for terminals (e.g. automated teller machines (ATMs)), screens, etc. -- and to software firms (e.g. requirements for particular types of user interface, for algorithms for handling demographic information, etc.).

8. There are other ways in which the service sector can be involved in technological development processes. Service firms often stimulate technological development in suppliers and/or clients. There has been considerable documentation, for instance, of the role of supermarkets and department stores in influencing food and other manufacturers concerning product quality, product development, packaging, etc. -- most notable, recently, in mediating consumer demand for "green", environmentally-safer products to farmers and chemicals companies.

9. Influence is also being exerted on the use of new technologies by suppliers to service firms, in governing their production processes or in mediating linkages to the service firms. For instance, they may be requested to make use of computer-aided design (CAD), electronic data interchange (EDI), or quality control procedures that require new technology. Clients, too, may be influenced in the direction of using new technologies -- for example, by being offered improved services through IT networks (as in the case of holiday companies offering videotex booking systems to travel agents). Both suppliers and clients may be provided with technical support from proactive service organizations (for example, the costs of training travel agents in the use of videotex systems may be borne by the holiday companies -- but not without some hope of "locking-in" the agents to their own particular systems).

10. Fifthly, IT is of particular importance to the discussion of the role of services in technology transfer. Services can play significant roles in the transfer of any technology, in principle, but it is IT that services themselves are extensively using. The IT revolution means that IT applications form a set of strategic technologies whose successful transfer is at issue. As sectors of advanced IT use, services may form a model for other potential users, in essence acting as a demonstration effect. They may provide a source of skills and training, or they may drain off scarce skills from other industries. Given the highly regulated nature of many services, their patterns of technology acquisition may be strongly conditioned by policy decisions. It is widely asserted that IT is leading to increased tradeability of many services -- and that, associated with this, the need for physical presence, or at least the physical presence of management, is being reduced. The extent to which these developments are materializing, and their implications for technology transfer, require investigation.

11. As more services can be delivered via telecommunications (e.g. online databases) or other electronic media (e.g. videotapes), incorporated (at least in part) as software (e.g. expert systems), their tradeability may grow. In a liberal trade regime, this implies increased international competition in services. This, in turn, may imply greater *international* concentration in these services, alongside greater competition in *national* markets. This process seems to characterize, for example, consultancy and engineering services, financial services and telecommunications. Foreign competition is liable to provoke more rapid change in services in many countries.[2] There are also possibilities for national services to begin to enter world markets -- and these opportunities have been seized by a number of developing country construction and engineering service firms, for example.

12. Related to the issue of internationalization is the issue of centralization of decision-making. Again, opinion is divided as to whether the capability of IT to transfer information rapidly, in volume, over extensive geographical distance, is promoting greater decentralization of activities (with responsibility being shifted to branches and local operations), or greater centralization (with all major decisions being taken at head offices, leaving only minor issues to be settled in other of-

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[2] See Enderwick (1989) for an overview of transnational corporations' service activities. Dunning (1989) presents a concise account of these issues, too.

fices). Research results suggest that, at present, the main trend has been for new technology-based activities to be concentrated in core geographical areas, and in some newly arising "innovative *milieux*".[3]

13. In organizational terms, a rather complex restructuring of decision-making is often the case, with precise details shaped by a variety of factors internal and external to the organization in question. Some commentators have forecast a proliferation of services and suppliers, with the "twilight of hierarchy", the disappearance of intermediaries, and the fragmentation of large organizations. However, current performance generally suggests that big actors -- for example, large financial companies -- will maintain dominance over their sectors, becoming global corporations. While economies of scale in production may become less important, increasing returns to capital earned from the concentration of information and control will continue to play a key role in determining patterns of competitive advantage.

14. Sixthly, acceptance that new technologies constitute a technological revolution carries with it several implications. According to the increasingly influential neo-Schumpeterian analyses of technological change,[4] technological revolutions are not just a matter of the production and diffusion of new products and processes. A technological revolution also, crucially, involves the emergence of new techno-economic paradigms -- new patterns of organization and of "best practice" -- which also have to be developed, experimented with, learned, and modified. This is liable to be a protracted process, extending over decades. The associated uncertainties create some opportunities for new entrants to challenge established market leaders; however limited access to the new core technologies and competences may further disadvantage some lagging firms and countries.

15. Research in the neo-Schumpeterian tradition thus raises questions for many established approaches to the development of technological capabilities. For example, with radical technological change, incremental "learning-by-doing" may be undermined, or at least required to alter its form substantially, as existing technical capabilities prove irrelevant to the operating principles of the new core technologies.[5] These six introductory points having been made, an examination of a number of major issues concerning technology in services follows.

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3 For a synthesis of the voluminous literature on this subject, see Castells (1990).

4 E.g., Dosi *et al.* (1988).

5 Thus, the interest in "unconventional technology transfer" (Meyer-Stamer, 1990).

Chapter I

INNOVATION AND TECHNOLOGY TRANSFER

A. Main categories of technological change

1. Radical innovations and technological revolutions

16. One of the most important tendencies in innovation research in recent years has been the shift in focus from studies of single innovations to studies of systems of innovations. Some features of this shift are discussed in the following subsections. Efforts have been made to examine different classes of innovation, in particular distinctions that have been drawn concerning how far an innovation may be a trigger to subsequent innovations. Whereas many pioneering studies of innovation were case studies or matched comparisons of sets of innovations, attempting to define what led to their success or failure, there has been a trend in recent studies to examine "swarms" of innovations.

17. An particularly influential effort to distinguish between classes of innovation has been made by Freeman,[6] who identifies a number of distinct levels of technological innovation: incremental and radical technical innovation, new technology systems and technological revolutions (see table 1). Essentially a hierarchy of innovations, it is ordered in terms of the degree to which they open up technological potentials which can be exploited by subsequent innovations. This classification helps bring clarity to a phrase that is often invoked: "IT is a revolutionary technology". Freeman's typology suggests that there is utility in distinguishing revolutionary technologies from other types. This approach has been elaborated on by other commentators.

18. In particular, Perez[7] attempts to specify what underlies the process whereby a technological innovation becomes a technological revolution. She argues that the innovation must involve a heartland technology -- one which performs functions inherent in a very wide range of production processes. Moreover, the innovation should move this heartland technology along a trajectory which yields drastic and continuing reductions in cost and/or increases in capability of performance of functions.

19. In a technological revolution, the potential of a new heartland technology is being exploited (a) across a wide variety of production processes and (b) in a wide variety of products -- some of these intermediate goods and/or services being used in the production processes, some as final goods and/or services being supplied to consumers. There is said to be a "swarming" of innovations, with the generation of many new products and clusters of new products, as innovations are built upon innovations.

20. New information technology (IT) appears to be a revolutionary technology in the sense outlined above -- it is a heartland technology undergoing substantial improvement in capabilities:

- *Decreased cost* of information processing (which means that bulk or very intensive operations can now be carried out that were once unthinkable);
- *Decreased size* of equipment (new technology can be incorporated unobtrusively into existing devices, or installed in locations where large artefacts would have rendered the application nonviable);

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6 Freeman (1988).

7 Perez (1983, 1985), Freeman and Perez (1986).

Table 1

The Freeman classification of types of innovation

Incremental innovations:

- Occur more or less continuously;
- Often the result of inventions and improvements from engineers, workers in production processes, or suppliers responding to user suggestions;
- Usually small modifications requiring only minor changes in training, working practices, etc.

Radical innovations:

- Discontinuous events;
- Usually result from R and D activities, usually supplier-driven;
- Often combine product, process and organizational innovation; require new training, manuals, etc.; may create new markets or extend old ones, but impact generally localized to a specific branch or sector.

New technology systems:

- Discontinuous events, but developing over a relatively long period;
- Combine radical and incremental innovations which are technically and economically related, as when a new set of products finds application in a set of related industries;
- Involve substantial organizational innovation, new markets, etc.

Technological revolutions:

- Discontinuous events that mark epochs in economic development;
- Combine several new technology systems simultaneously: i.e. new heartland technologies are developed that can be used innovatively across a very wide spectrum of economic activities;
- Require many social, institutional and organizational changes; take a long period to diffuse and develop.

Source: Thomas and Miles (1989), based on Freeman (1988).

- *Speedier* information-processing (largely in consequence of overcoming the batch-processing system, but also reflecting faster data transmission and more integrated systems);
- *Increased reliability* of equipment (fewer mechanical components or non-integrated components to go wrong);
- *Digitalization* of information of all kinds (speech, video, text, graphics, etc.) making it possible readily to transfer data generated via one medium to different media (thus the same material may be embodied in a printed paper text, as "hypertext" on a CD-ROM, as interactive source material on an online database, and so on);
- *Increased quality and user-friendliness* of systems as "spare" processing power is applied to error-checking, to providing more choices to users, for "intelligent" or "user-friendly" front-ends, etc.;
- Reduced cost of data-processing means that *distributed* rather than centralized processing facilities become feasible and often common sense methods of handling problems (indeed the processing power of "terminals" or network nodes may outstrip that previously possessed by the hosts);
- Growing importance of the role of *"software"* of all kinds, both in terms of contribution to systems performance and utility, and in terms of production costs -- though reproduction costs typically decrease very substantially. (Software includes texts and broadcast programmes as well as systems and applications programs for computers and microprocessor-controlled devices: the former are familiar from traditional electronic media, but the latter enable exploitation of a key property of new IT-programmability).[8]

2. *Techno-economic paradigms*

21. Freeman and Perez, together with others, argue that IT will be the basis of a new "techno-economic paradigm".[9] The argument may be summarized as follows: in the course of a technological revolution, the diffusion of a new heartland technology substantially affects activities across a wide range of production processes -- with changed perceptions on the part of managers, engineers and workers of the relative costs and capabilities of different factors of production. Operations that were previously out of the question now become economically or technically possible; some skills become redundant while new ones are required; goods and services on offer from suppliers change, as may the demands of users. Perez has referred to a "new common sense" developing in production, although this takes time as all the difficulties of "learning-by-doing" are reproduced many times over.

22. Some authors regard the term "techno-economic paradigms" as referring to change at the level of the whole economy -- the creation of new industrial structures, training systems, social institutions, etc. Others delimit the notion to change in production processes, perhaps even in single industrial sectors or -- in some cases -- in specific firms. In this study, the term will be restricted to the more modest efforts of specifying emerging production practices in branches and sectors.

23. There have been efforts to identify the main features of the new techno-economic paradigms that may emerge through the application of IT. Such accounts place great emphasis on the programmability, interactivity, and networking capabilities of IT.

24. Programmability means that it is possible rapidly to reconfigure equipment, making possible economies of scope, flexible production lines, and greater customization of products. Some authors propose "flexible specialization" as a widespread form of industrial practice -- but others point out that different sectors and regions may well respond in diverse ways to IT opportunities.[10]

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8 This list derives from Miles (1988b).

9 E.g., Freeman (1987), Perez (1988), their and others' contributions to Dosi (1989), Miles *et al.* (1988), etc.

10 For a useful account of the debate, see Wood (1989).

25. Interactivity means that IT systems can perform tasks in ways that were previously restricted to human operatives -- thus it is possible to interrogate online databases and receive material organized in a manner unique to one's specifications; interactions with bank and insurance companies may be handled outside of office hours or conventional office locations, etc.

26. The networking possibilities of IT mean that it is possible to link up discrete devices into systems, enabling new spatial patterns of organization, and new activities such as offshore office work. Thus, it is argued that the emerging "style of industrial production" involves the *integration* of different activities in the productive chain. Manifestations of this include, for example, computer-integrated manufacturing (CIM), just-in-time delivery systems, local and wide area networks, management information systems. Attention has been paid to integration for enhancing efficiency (reduced stock levels, less wastage, better co-ordination, and, repeatedly, savings of time and labour). It may also be argued that integration is one of the main elements in the achievement of greater flexibility in production and more rapid accommodation of the quantities and qualities of products to market trends. This heightens the importance of suppliers linking with customers in a new context. Services that help integrate production (e.g. managed data networks to carry large volumes of data between various sites of a firm; electronic data interchange to allow firms to obtain relevant information rapidly) or integrate production with the market and financial system (e.g. online financial services, credit checking, teleshopping, etc.) play an important role in this vision.

27. Considerable evidence exists to show that firms are using IT -- together with organizational change -- to develop new methods of operating. In particular, attention has been paid to developments among manufacturing firms, where advanced "flexible firms" are reported to be engaged in strategies that enhance user involvement in product design, reduce storage and move production closer in time (and sometimes in space) to consumption, etc. It is interesting to note that these are features more commonly associated with services than with manufacturing firms. There has been much discussion of emerging techno-economic paradigms in industrial organization, particularly among manufacturing firms. Table 2 highlights some key features of these accounts.

28. Several factors are liable to constrain and shape the development of new techno-economic paradigms:

- The creation of a new paradigm means the diffusion not just of technologies, but also of new working practices and perceptions. In practice, established institutional structures may be resistant to change, not least because possessors of managerial power or craft skills may be unwilling to make way for (or learn) new work practices;

- New paradigms are made, not given. There may be some diffusion of "orgware" in the sense of "learning-by-example", that is copying models promoted by the media, trade associations, consultants, system suppliers, etc. However, there will very often be innovation as a result of the users' own learning-by-doing experience. Only experimentation with new patterns of organization will establish which ways of utilizing technological potentials best secure an organization's goals within the framework of its resources;

- The formation of a new style of production is rarely a matter for the individual organization. Can internal changes in one organization really yield dividends without being linked to changes in supplier and client sectors? Different institutions may pull in different ways: the priorities given to training, to standards, etc. may diverge according to the maturity and the types of IT application in different sectors;

- The choices are not simple: in many instances several technological and organizational alternatives compete to achieve the same ends. Users may be baffled by the array of alternatives, or wary of accepting advice from consultants or other actors whose interests may lie more in promoting a particular system than in improving the quality of service to users. Thus there may be considerable hesitation about committing oneself to what may be an expensive course of technological and organizational development;

- A major factor constraining diffusion of IT-based innovations is doubts over standards. In a succession of instances, users and potential users have faced problems owing to systems operating incompatible standards. Large users may be able to ignore such debates (but not if they wish to interface with other users); many users may be reluctant to commit themselves to an IT system when standards remain in dispute;

Table 2

New techno-economic paradigms in manufacturing

Production process

(1) Use of information systems to reduce stocks and inventories by organizing the delivery of items when needed (just-in-time);

(2) Increased flexibility of production so that standardised items can be 'customised' or at least batch sizes reduced economically (economies of scope brought about by technologies as diverse as 'mail merge' systems on word processors and computer-controlled numerical machine tools, both of which allow outputs to be 'customised' to individual clients);

(3) Associated with the above developments, closer linkages between production itself, the design process, and market information (CADCAM, EDI, EPOS-linked recording of sales and stocks);

(4) Shortening of product life-cycles in some areas of production (e.g. many more ranges, in stock for briefer periods, in the apparel industry), leading to requirements for more flexibility in firm structure and workforce skills, and to greater attention being paid to product innovation.

Organizational change

(1) A reorganization of the logic of centralisation and decentralisation as planning and execution are brought closer together, and a redistribution of the spatial division of labour between different components of firms;

(2) New patterns of user-supplier relationship, based on more intensive interchange of information, and with scope for the reassignment of responsibilities (e.g. for design) among partners;

(3) Contracting-out of some firm activities in order to maximise flexibility, to cope with shorter product cycles, and to reduce costs and planning requirements;

(4) Conversely, some marketing of in-house services, especially those developed for the purposes of company information needs that can now be successfully commoditised;

(5) Increasingly global scope of operations in many sectors, with new patterns of collaboration at an international level emerging, and with associated shifts in patterns of government-industry technical co-operation;

(6) And in general, a growing importance of informational functions in organisations and in production processes, and associated requirements for new forms of information management.

Source: Miles (1989).

- Related to the issue of standards, are the doubts over the future-proofing of current IT systems as long as both the heartland technologies and applications continue to undergo rapid technological change. Users are reluctant to invest in what may soon become obsolete systems.

29. As this list indicates, innovation using IT hardware in services, the creation of new services, and even user's adoption of new services, are liable to be risky. Suppliers face development costs, users face investment costs and the challenge to existing ways of organizing their business. Equipping a whole chain of travel agents or hotels to make use of videotex, for example, involves layouts on networks, terminals, software, training, etc. If the wrong system is chosen, it may become more difficult to switch to a better one. Investment is not a smooth and continuous process, but is rather "lumpy" (in terms of time and energy, as well as money); to some extent it also sets trajectories. It is not just a case of replacing one item of machinery for a bigger or faster one; IT users may have to change the way the organization works, cutting across established occupational and departmental boundaries, creating new budget headings, even changing the scope of the business in which the firm is involved.

3. National systems of innovation

30. Innovation research has moved towards a more "holistic" focus in several ways: in the shift from single innovations to the study of technological revolutions and techno-economic paradigms, and in the attention paid to the social networks through which innovations are diffused, for instance. A third aspect of this trend is also important to the present discussion: the analysis of national systems of innovation.[11]

31. National systems of innovation have gained attention in the face of quandaries over the divergent technological performance of different countries. Some developing countries seem to have accomplished more successful technology transfer than others; some industrialized countries have been at the forefront of scientific achievement, yet have had trouble retaining competitive industries; some small countries have been able to compete in high-tech innovation against their larger rivals despite expectations that they would be unable to marshall enough resources to remain in touch with the leading edge of advanced technologies. While the international dimensions of research and development have clearly an important influence on countries -- especially smaller countries concerned with staying abreast of "technological frontiers" -- the social structures that link together scientific researchers, industrial producers, and users of equipment in industry (including services) and society at large should be highlighted.

32. The national system of innovation may be considered a structure within which stocks of knowledge and patterns of information flow are organized. "Learning-by-interaction"[12] includes, in addition to learning-by-doing, also knowledge about the ways in which communications between producers and users (and other agents, such as national policy-makers and training agencies) allow for the transfer of skills and experiences across sectors, the identification of bottlenecks and other problems to which innovation should be directed, inducements to make investments, openness to new producers and products, etc. Effective and integrated learning requires relatively stable forward and backward linkages in the national economy, a stable or limited scientific basis for production, and a degree of flexibility in products, processes and organizations. However, learning must be open to new possibilities if an economy is to remain innovative in the context of changing international technological frontiers. Particularly important in these national systems is the relation of learning to strategies for seeking out and locating new knowledge, products, processes, and problems to be addressed.

33. Various search strategies may be adopted. Since industrial R and D is liable to be focused on relatively short-term economic goals, one of the most common strategies for searching for long-term technological knowledge is the use of institutions of basic research (colleges of higher education, etc.). Part of the success of certain national systems of innovation seems to lie in the nature of the relations between sources of basic scientific and technological knowledge and industrial R and D, producers and users. These relations allow for flexible search strategies to be in-

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11 The present discussion draws extensively on Freeman and Lundvall (1988).

12 Andersen and Lundvall (1988).

tegrated with more limited learning strategies: they involve neither high subordination of basic research to industrial needs, nor a relation of complete independence between the two.

34. How do these ideas relate to the earlier discussion of techno-economic paradigms? Freeman[13] notes that the opportunities for exploitation of new heartland technologies will depend upon:

- Access to these technologies through trade (in the case of non-producers). It does not appear to be necessary to be able to produce all the major new technologies in order to develop competence in the new techno-economic paradigms and to retain competitiveness;
- Capabilities to apply the technologies in many parts of the economy: to use them, perhaps as part of a new specialization in the international division of labour;
- Capacities to modify and improve the new technologies, and generate new innovations from them; thereby producing part of the growing range of new products based on the technological revolution, as appropriate in terms of local resources and markets, etc.

35. If these capacities exist or can be nurtured, then there may be considerable scope for countries to begin to exploit opportunities presented by the emergence of new techno-economic paradigms. Indeed, it is sometimes argued that these are "windows of opportunity" -- in the long period of transition to new modes of industrial organization, with considerable uncertainty as to which of the various efforts at creating new paradigms will come to be dominant, more scope may exist for new entrants. There may even be some chances of "leap-frogging", for instance by moving into digital telecommunications systems without having followed all of the evolutionary stages of analogue systems that have characterized this development in industrialized countries.

36. However, the extent to which these opportunities exist and can be grasped will depend considerably upon national circumstances. Technology policies which can cope with technological revolution will need to be directed at components of the national system of innovation. This may involve developing basic research institutions which can support national search strategies, and learning by interaction and by doing. It may mean developing technical (or telecommunications) infrastructure and skills. Participation will certainly call for "specialised local knowledge of application requirements...adequately linked to technological capability...The presence of skilled and experienced people with the necessary connections to the world scientific and technical infrastructure."[14] This discussion has considered some of the general points emerging from ideas of national systems of innovation and of technological revolutions which are relevant to the transfer of technology.

B. Technology transfer and services

37. Technology transfer has long been recognized as a critical issue for national development strategies. Overwhelmingly, however, discussion of technology transfer has been concerned with manufacturing and utilities.[15] The technological revolution underway in services makes this situation quite anachronistic.

38. The emergence of services as leading technology users, and as significant vectors of the diffusion of new technologies, means that service activities and organizations have to be taken into account in efforts to promote technology transfer. This affects service trade. The delivery of services to a recipient country (or production of services within it by an overseas supplier) may involve the use of new technology. Questions may be raised as to the effect of this on local service suppliers and hardware suppliers, and on the accumulation of local technical capacities. In addition it affects trade in goods and services that are used by service industries. The choice of technique and the development of technical capacities to capitalize on this choice can be a critical issue here.

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13 Freeman (1988) p. 77 passim; we also draw on Perez (1988), pp. 92-94.

14 Freeman (1988), p. 82.

15 Shelp *et al.* (1984) is an exception, presenting a set of case studies of technology transfer by service transnational corporations.

39. These two cases differ in terms of the policy questions and instruments involved, but there is also considerable overlap in the issues raised. In particular, the dilemma of choosing between short-term advantages (immediate pay-offs and savings) and longer-term objectives will often arise. Long-term interests depend on the development of local technical capacities (over and above those limited skills required to operate equipment), a factor which demands particular attention. Deeper forms of knowledge and expertise concerning new service technologies are important if lessons are to be learned from foreign service innovations (these lessons may be applied beyond the immediate service sector from which they derive). So as to maintain competitiveness and dynamism in one's own services or -- at the very least -- improve one's competence in future technological choice and in negotiating with foreign service and technology providers, these lessons are vital.

40. Four distinct types of decision circumstance may be identified:

(a) *Purchase of science and technology-related services.* Examples might include the use of foreign engineering or construction consultancies.

(b) *Import via physical presence* of foreign service facilities, as in joint ventures, franchising, or foreign direct investment (FDI).

(c) *Purchase of information services*, delivered through new telematics media or through electronic or audiovisual media. Examples might include the use of databases hosted on computers in other countries, or of software imported on floppy discs. The purchasers might be in any sector of the recipient economy, including manufacturers and final consumers (e.g. for entertainment products).

(d) *Purchase for local service organizations* of IT-based hardware or software. Case (c) covers many special cases of this, but could also include as examples the importation of telecommunications equipment for banks or audiovisual teaching aids for the education sector, for instance.

41. Each of these cases forms a topic worthy of attention, and one that is liable to be influenced by national and international policies on trade in services. Service trade arrangements will condition the degree and pattern of service imports of developing countries, and this is liable to affect the extent and form of the transfer of technology through services trade. These arrangements will also have impacts upon service exports from developing countries. While the level of service exports will in part depend upon the effectiveness with which technologies are used by the firms involved, exposure to competition on the world market can stimulate the acquisition of local technical capabilities. The present discussion will mainly emphasize the first of these issues -- service trade from industrialized to developing countries[16] -- and case (b) in the list above, that is, technology transfer that may be associated with service imports and especially with the physical presence of service suppliers.

42. Transnational corporations (TNCs) are liable to be particularly advanced in their use of ITs. They have the advantages of: strong links to advanced economies and developments therein, and greater awareness of technological and supplier alternatives; sufficient finance and scale of operations to achieve economies of scale (bulk purchase, investment in the development of new systems); and the financial clout to achieve discounts and other concessions from suppliers. Thus, in principle, TNCs form a rich source of knowledge and practical experience about the application of IT to services.

43. There has been much scepticism as to the willingness of transnational corporations to support more than the most rudimentary forms of technology transfer, unless pressured into doing so by relatively powerful host Governments. Some service industries may be characterized in this way: for instance, mass media such as broadcasting and cinema may serve as distribution channels for products made in industrialized countries but have little impact (other than cultural) on the recipient countries.

44. Many professional services, in particular, seem to take another form, however. They require high skill and technology levels in local staff and operations; responsibility and judgement have to be exercised at local levels owing to the close fit needed between the services and local clients and cultural conditions; competition is based on continuous innovation rather than on a one-off

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16 However, this focus is chosen with the understandings that: (a) service competitiveness is an important objective of technology transfer policies; and (b) effective national services can support exports from, or import-substitution in, all sectors, and not just from services.

proprietorial advantage. Identification of which firms and sectors are most likely to engage in the more substantial technology transfer, and the conditions under which they would do so, is an important task.

Chapter II

SERVICES AND SERVICE TECHNOLOGIES

A. General approaches to services

1. Theories of the service economy

45. The service sector has grown to dominate Western industrial economies in terms of output and, especially, employment. Some commentators view this as meaning a deindustrializing economy (DIE). The DIE approach has its roots in the classical political economists' emphasis on the production of goods as the only source of value. Services dominate:

- In part, merely because of the relative decline of manufacturing industries, thus reflecting not just increasing efficiency (which might reduce employment levels), but also the international migration of productive activities;
- In part, owing to an absolute growth of services, which mainly constitutes an unproductive burden on manufacturing industry.

46. In dramatic opposition to this view is the theory of the postindustrial economy (PIE) which assumes that the rise of services reflects their status as "superior products". Related to this is the assumption that with increasing discretionary income people will opt to consume an increasing proportion of services. Demand for material goods was reaching saturation, and given the expected impacts of automation on manufacturing employment, it was fortunate that services employment growth looked assured. Many accounts of the "information society" rest on a similar logic, except now it is information technology (IT) and other information-related services that are seen as the future growth areas, while some traditional services are expected to go the way of manufacturing.

47. The two views are associated with distinctive ideas about the nature of services (table 3). Their contrast is so acute that one might think they concern different sectors altogether. Indeed, to some extent the proponents of these two views actually have been using different definitions and samples of services -- excluding "high-tech" services from the DIE account, including professional white-collar work in the PIE version. The ability of serious commentators to disagree so remarkably reflects the heterogeneity of the services sectors of the economy.

48. An elementary breakdown of the services sector distinguishes between activities that are mainly *public services*, (i.e. those catering to aspects of collective and individual welfare such as health, education, government administration); those that are mainly conventional *consumer services* (such as entertainment, domestic service, hairdressing); and those that are mainly *producer services*, sometimes termed intermediate services, (mainly supplying services to other firms, as do office cleaning, computer software, accountancy). The three branches of services have different market structures and dynamics of demand (respectively: political decisions, consumer decisions, industrial decisions).

49. Drawing on the comparative statistical analyses of Elfring (1989), a brief summary can be made of the development paths of these three sectors. Until the 1980s, public services played a dominant role in services growth. More recent efforts to curb growth in these services and to restrict government expenditure in general suggest that government attitudes to these services parallel the DIE perspective. Consumer services follow a different pattern. They are more income-elastic, so that increased affluence leads to expansion of demand. However, there is little evidence that consumer services in general have greater income elasticities than consumer goods, as is assumed in the PIE approach. Some consumer services have displayed rapid growth, but in

Table 3

Contrasting views of services

Services:	DIE	PIE
Underlying image	"Stuck in the past"	"The coming thing"
Value	Usually unproductive	Often superior goods
Economic role	Burdensome on other sectors; especially public services	Job generating; contribute to overall quality of life; public services help coordinate complex economy and society
Innovation	Economic growth based on innovation in manufacturing; services in contrast lag in productivity growth	Often substantial innovation, organisational as well as technological
Skills	Usually low-level	Often demanding high social and technical skill
Quality of working life	Jobs often low status, part time, low wage	Jobs often professional and rewarding knowledge work

Source: Miles (1989).

other cases expansion has been limited by relatively low rates of technological innovation which have been associated with increases in prices and low levels of product-quality improvement (as compared to competing goods).

50. The third class of services, producer services, tend to be overlooked in the DIE and PIE approaches. Many of these services have considerably increased their importance over recent decades. For example, the banking, insurance and finance sector has displayed the most explosive growth among services since the late 1970s, as a result of increasing its range of outputs, speed of response, and international scope. It represents an instance of the way in which IT has catalyzed the growth of some existing services and allowed the development of new service products. "New" services such as management consultancy, market research, document processing and copying, and professional and technical decision supports are likewise displaying rapid growth.

51. The growth of producer services reflects several factors, although these are not always easy to quantify. The use of new technology in all sectors of the economy results in the demand for greater "intelligent inputs" to products -- leading to greater purchasing of professional and technical services. Another factor which will be reflected in statistics as a growth in services employment and a decline in manufacturing is the tendency for firms to contract out service activities -- not only those inessential to their survival (such as cleaning and routine maintenance) but also more strategic activities to facilities management and consultancy operations.

52. The DIE and PIE approaches, treating services too homogenously, fail to address the linkages between services and other sectors of the economy. Thus, both approaches fail to shed light on the shaping of demand for services, and the role of services as users of, and agents in, technological innovation. Going beyond merely reiterating that services are heterogeneous, it is possible to draw on threads of the arguments presented above to construct a third account. This has been

termed the new industrial economy or (to avoid confusion with "newly industrializing countries" or NICs) the neoindustrial economy (NIE) approach (Miles, 1989), or, as in the European Community's FAST Programme, the Meta-industrial Economy.

53. This approach stresses a few simple perceptions:

- Manufacturing and service industries are becoming increasingly alike, as both mutate away from their traditional forms;
- Manufacturing and service industries are becoming increasingly intertwined; as their interdependencies grow and their production processes overlap.

2. Manufacturing and services: moving together

54. In the earlier discussion of new techno-economic paradigms, it was noted that many features attributed to the new organizations of manufacturing firms are similar to those commonly attributed to services. But services have also been moving towards manufacturing in certain respects. Commentators from the 1960s onwards have been discussing the "industrialisation of services", in particular.[17] In the early discussions, this involved drawing attention to ways in which services were emulating mass-production manufacturing, with fast-food perhaps being the archetypal success story cited. In this model, services products are produced in bulk, with product quality kept consistent -- and while there may be considerable variety in the product delivered, this is engineered via combinations of standard components rather than by the traditional, informal negotiation between customer and service producer.

55. Another strategy has been for firms to reduce the costly personal service components of activities by introducing customer self-service (launderettes, retail stores, restaurants), and thus reducing the element of personal contact with consumers. IT can facilitate both the mass-production and self-service trends -- sometimes in combination, as with automated teller machines (ATMs). Service products can be mass-produced, and less bound by space and time (many services can be stored and delivered electronically); service work becomes more centred on human-machine combinations and less on interpersonal interaction, with a growing importance for technical skills; the sector becomes capital-intensive and (though there are problems in output measurement) it quite possibly will display rapid productivity growth.

56. These developments mean that services and manufacturing are in many respects converging, mutating towards forms of organization that synthesize certain of their (previously) distinctive attributes. The convergence of manufacturing and services noted above involves both sectors moving to new forms of organization, not just one emulating the other. The adoption of mass production-like features by services does not mean that services are not themselves seeking to achieve more process and product flexibility, just like manufacturing. These new forms of industrial organization, with shifts in the boundaries and relations between sectors, are important features of the NIE.

57. While the trends are heavily influenced by changes in international competition, by shifts in markets and market demand, as well as by political evolution (notably de/reregulatory policies), the role of IT is nonetheless substantial. By making low-cost and high-power information processing applicable in a vast range of economic activities, IT is promoting changes in the traditional common sense approach to production, leading to new logics for the design, creation and delivery of goods and services and for using the factors of production that they embody.

58. Increasingly it becomes inappropriate to consider manufacturing and services as contrasting sectors: they are becoming more alike as well as more integrated. From "manufacturing versus services" and "manufacturing or services", attention will need to shift to "manufacturing and services". In other words, the combinations of manufacturing and service activities that underpin a new industrial economy should become a key focus of attention. These combinations may not be universal, since they may vary with national size, factor endowments, and so on. Nonetheless, this convergence and integration of sectors is becoming a key element in growth.

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[17] See Levitt (1976).

59. Manufacturing and service industries are becoming increasingly intertwined in a number of ways. This is apparent, for instance, in patterns of corporate ownership. The linkage is visible in the economic interdependence between sectors -- the growth of producer services catering to other sectors of the economy. The growing use by services of IT produced by manufacturing sectors further attests to this. In all sectors, adoption of new technologies and establishment of new organizational strategies are associated with evolution in the role of services used by industries. While the growth of producer services is often seen as being merely the externalization of in-house activities by manufacturing firms, this is far from being the whole story. New technology is increasingly important as a factor in the demand for producer services. This is obvious in cases such as software and telecommunications services. More widely, there has been considerable growth in both in-house and external activities designed to allow firms to achieve the greatest possible value-added from the use of new systems. Competitiveness in manufacturing increasingly requires the utilization of sophisticated services in the total commercial process -- service inputs from product identification, design and development, through commercial manufacture, to marketing and sales. (These services functions may themselves be closely integrated, as when CAD is used to bring sales and design processes together -- e.g. the customer effectively specifies the characteristics of the car that is desired, for example, using the "front-end" of CAD software.)

3. Services and innovation: "peculiarities" of services

60. As noted above, services are quite heterogeneous. Their variety of products, and of markets, makes generic descriptions of services extremely difficult. The literature is nevertheless full of lists of "peculiar features of services", typically derived from particular kinds of service (cf. Norman, 1984). Attributes of service products, of production, and organization frequently mentioned include:

- Service *products* are immaterial. Unlike goods, it is said, services cannot readily be stored, demonstrated in advance, transported or traded internationally. (However, computer software is a good example of a service which evades all of these limitations).

- Service *production* and consumption typically take place together, it is said. They occupy the same time and space. It is also suggested that service production is usually non-continuous (thus limiting economies of scale), and that it furthermore requires customer participation (this is sometimes labelled "consumer-intensivity"). (Many telecommunications and broadcasting services evade these criteria.)

- The *organization* of service activities is also said to be unusual, as compared to manufacturing. Characterized by a high degree of regulation (this is often associated with: the difficulty for consumers to evaluate the service in advance; concern about the strategic or social importance of the service; or the professional skills required). Such organization often involves State control (e.g. welfare services). Services are often said to have peculiarities in terms of their scale and their labour requirements: services feature high levels of informal-sector activity, of self-employment, and of family and small-firm participation; services may involve extremes of professional or unskilled staff; the sector is generally believed to be labour-intensive with low levels of capital investment and technology (and thus also featuring few technically skilled workers). (Transport services are often clear exceptions to these rules, especially, air transport.)

61. These "peculiarities", it will be apparent, are pointers to the features of many services, but far from descriptive of all services. In many respects, they provide guidance as to the characteristics of many traditional services, but apply to few of the newer professional and IT-based services. As new technology is applied increasingly broadly within services, the peculiarities listed become less and less applicable to the broad range of service activities.

62. However, the "peculiarities" do relate to the factors that have led many services to be *relatively* resistant to technological innovation -- at least until the emergence of new IT. With very few exceptions, the core tasks of service production and delivery have been largely left in human hands. In part this reflects the "tailoring" of services to specific individual clients (or groups of clients) or to specific times and places. Before the development of new IT, it was unrealistic to expect technology to be responsive to these specific circumstances. The costs of processing data

were so high that automation in services was restricted to extremely limited sets of physical storage and cash transactions (e.g. vending machines), and to instances where the service could be standardized (e.g. fast foods). The use of electronics took the forms of computerization of basic and routine administrative and financial activities (information-processing), or of distribution of broadcast material and voice telephony (information-transmission).

63. These considerations suggest that different types of services may have had, and may well continue to have, distinctive technological trajectories. Before considering whether a classification of services into different groups can help identify such trajectories for policy purposes, it may be useful to refer to a recent attempt to theorize the process of innovation in services.

4. The reverse product cycle

64. On the basis of statistical analyses and case studies of British service organizations, Barras[18] has concluded that many services are displaying a shift in their capital expenditure. The proportion of investment in plant was decreasing relative to that in equipment (i.e. from buildings to IT). He has drawn an analogy between this and the industrial revolution in manufacturing, when investment in plant (factories), associated with changes in work organization, paved the way for the investments in machinery that supported continual change in industrial processes.

65. Barras goes on to describe the process of innovation in services in terms of a "reverse product cycle". This is a deliberate contrast to the conventional product-cycle model for manufacturing. In the latter model, innovation begins with the development of a new good, and for a period focuses on improving the design, etc.; subsequently, markets expand and the scale of production increases; the innovative effort focuses on lowering prices. Product innovation was the forerunner of process innovation. Barras claims that the reverse characterizes the current wave of innovation in services.

66. Underlying this pattern of innovation is the dynamic role of manufacturing as a source of process innovation for services. Service innovation begins with new processes, based on new technologies generated in manufacturing sectors. It typically involves increasing the *efficiency* of the production or delivery of existing services. Subsequently, increases in the *quality* of the service may be achieved as the new processes are mastered. (Thus, automation may allow extensions in the availability of a service beyond normal office hours; data bases may permit providing clients with more and better information or with services tailored more closely to their own circumstances.) Eventually, *new services* may be produced using the process technology. (For instance, computerization may mean that data bases and data base systems can be organized in new ways which permit new applications.) Table 4 reproduces Barras' illustrations of service innovation.

67. The reverse product cycle account has been influential precisely because it does correspond to what observers have described as happening in many services. In part, this may well be because IT is being applied to the office components of many service industries (on which more below), and the reorganization of service management which this facilitates can be the basis for innovations in service delivery -- thus, once information has been computerized, it may be possible for clients to access computer systems themselves, rather than needing to go through a human intermediary. However, the model may be treated too rigidly -- and like the "peculiarities" of services, it may not apply to all services. Indeed, one peculiarity -- the fuzziness of the distinction between process and product -- is liable to mean that it is hard to have process change without product change.

68. More significantly, perhaps, some services are far from being passive recipients of innovation from manufacturers. Indeed, some equipment-intensive services, such as transport and telecommunications, have often been very specific as to the sort of goods that they would like manufacturers to supply. With the pervasive use of IT, software innovation seems to be very common within those services that are making extensive use of IT.

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[18] Barras (1984a, b).

69. Thus accounts of service peculiarities and reverse product cycles are useful, but frequently misleading. In large part, the problem is that these accounts treat services in a fashion that is too homogenous. Diversity of services may be considered in more detail, in order to assess how far specific types of services involve different trajectories of IT use.

Table 4

Barras's illustrations of the reverse product cycle as manifest in computer applications in three service sectors

Stage of cycle	(1) Improved efficiency	(2) Improved quality	(3) New products
Periods:	1970s	1980s	1990s
Computer: technology	Mainframes	Online systems: minis and micros	Networks
Sector applications:			
Insurance	Computerized policy records	Online policy quotations	Complete online service
Accountancy	Computer audit; Internal time recording	Computerized management accounting	Fully automated audit and accounts
Local Government	Corporate financial systems (e.g. payroll)	Departmental service delivery (e.g. housing allocation)	Public information services (e.g. viewdata)

Source: Barras (1986a).

B. Classification of services

1. Traditional approaches

70. The International Standard Industrial Classification (ISIC) groups services into four categories, each with a range of diverse industries within it:

- Trade, restaurants and hotels;
- Transport, storage and communications;
- Finance, insurance, real estate and business services;
- Community, social and personal services.

71. The rationale for this grouping is increasingly difficult to sustain. In particular, if one considers the emergence of IT-based technologies, classifying together electronic means of communication with physical transport is potentially extremely misleading.

72. Many researchers have recently adopted a classification of services proposed by Singelmann:[19]

- Distributive Services (trade, transport, communication);
- Producer Services (finance, business services, etc.);
- Social Services (medicine, health, government, etc. -- and also postal services);
- Personal Services (domestic service, hospitality, repairs, entertainment, etc.).

73. This grouping proves useful for analysing employment trends, in particular. It goes some way toward grouping services by their functions, although the "social services" group seems designed to capture services mainly delivered by government agencies in industrialized societies (thus the inclusion of postal services). However, telecommunications are still classified with physical transport -- why not together with post? -- while the producer services category contains many services that have consumer markets as well as business ones. The next two sections will present additional classifications which have been proposed as being suitable for the analysis of services trade issues and technological change.

2. A classification relevant to service trade

74. Building on earlier studies, Vandermerwe and Chadwick (1989) have proposed that the internationalization of services can be helpfully viewed by classifying services on two dimensions: the degree of involvement with goods, and the degree of consumer-producer interaction. Splitting the first axis into three groups and the latter into two yields six service classes; these are presented together with the authors' examples and suggestions concerning trade:

(1) ***Low goods, low interaction***

Examples: domestic postal services, knife sharpening.

International trade potential: limited in present form.

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[19] Singelmann (1978); for subsequent use see, especially, Elfring (1988) on employment patterns in industrialized countries.

(2) ***Medium goods, low interaction***

Examples: hotels, air freight, shipping, retail, couriers.

International trade potential: high - goods facilitating the service easily taken to foreign markets.

(3) ***High goods, low interaction***

Examples: books and journals, movie films, recorded programmes and programs on disc or tape, non-interactive IT services (e.g. online news).

International trade potential: exportable through transport of goods.

(4) ***Low goods, high interaction***

Examples: consulting, advertising, education, engineering.

International trade potential: exportable through movement of people.

(5) ***Medium goods, high interaction***

Examples: banking, personal travel, maintenance.

International trade potential: involves both goods and people.

(6) ***High goods, high interaction***

Examples: teleshopping, electronic mail, electronic diagnostics.

International trade potential: likely to become more significant.

75. The mode of internationalization of services can be related fairly readily to these groupings. Vandermerwe and Chadwick identify three main modes, ranging from minimal to high levels of investment, control and presence:

- The first is *exporting* (minimum levels): those items of group 3 recorded on physical media (books, films, discs, etc.) may be distributed through retail and other distribution networks.
- The second involves *reliance on third parties*: this applies to online elements of group 3, to groups 2 and 6, and to more goods-oriented aspects of group 5. Here investment and representation in overseas markets is required and realized through strategies such as franchising and licensing.
- The third is *foreign direct investment* (maximum): this applies to group 4 and to banking, involving sending of employees abroad or setting up branches of transnational firms.

76. Finally, Vandermerwe and Chadwick go on to discuss changes (especially IT-related changes) in this pattern. Globalization is leading to innovation in services, with, for instance, the development of niche marketing strategies, or the development of new organizational structures which allow for movement across modes of internationalization.

77. They argue further that present IT-based services and potentially a great many IT-using services, are beginning to occupy an "all-in-one" mode of internationalization. This mode is typically very dependent on telecommunications as a medium for supplier-client interactions and knowledge transfer. This inclusive mode can, as in the case of an information company (Reuters is the example provided), involve export of information products (news, stock exchange details, etc.), third party linkages (telecommunications network suppliers), and physical presence (terminals, local back-up). Many other services with a high information component can operate in a similar way using, for example, automated teller machines (ATM), insurance, electronic mail and telephone terminals, electronic funds transfer devices, computer autodiagnostics, etc. Such cases combine export features (the service, rather than the service supplier, is moved), third party links (especially infrastructure), and ongoing presence (systems procedures, ownership of technology and/or management arrangements with customer network).

78. This approach throws considerable light on developments in services technology and trade. However, its focus on goods and consumers as key elements in services, and its discussion of IT implications, seems to merge rather different types of processes. Some goods are IT goods and others are mechanical. For instance, some consumer interactions involve information exchange

while others are more concerned with people's physical or biological state. The scope and style of application of new IT to different services varies according to these distinctions. In the following section, an attempt is made to set out an approach to classifying services, which takes into account these functional differences.

3. A service product and process approach

79. The traditional approaches fail to discriminate among services in a way that is useful for analysis of technological change. The approach outlined by Vandermerwe and Chadwick, while useful for analysis of internationalization, is also limited in this respect. One alternative would be to classify services according to the type of transformation which they effect on particular types of "raw material". Since different types of transformation of different types of material, resulting in different types of service product, necessarily involve different technical operations, it is reasonable to expect that technological change will have different implications for services disaggregated in this way.

80. Building on the work of Hill, Riddle, and others, one way of discriminating between grand sectors of the economy[20] involves viewing:

- The *primary* sector as extracting raw materials from the environment via mining and agriculture;
- The *secondary* sector as transforming these raw materials into material goods, buildings and physical infrastructure, and into physical utilities such as water works and electricity supplies;
- The *services* sector as spanning a set of diverse functions, some effecting physical transformations (such as, for example, transport, storage and maintenance of goods), some changing the state of people themselves (via education, medical care and personal services), some acting upon information (telecommunications, broadcasting, office and administrative services, and those that deal with symbolic material such as money and property rights, etc.).

81. Three main classes of services based on the core processes of service activities -- what sort of material they are engaged in transforming -- are implied in the above discussion. These are *physical services* (i.e. those that effect physical change, such as transportation -- which allows passenger transport to be treated alongside goods transport -- and those that protect objects from physical change, such as storage, repair and maintenance); *human services* (i.e. those that effect biological and psychological transformations of people, such as health and education services); and *information services* (which process, store and transmit information and symbolic material -- including money and property rights; among these we can distinguish services that support IT, such as computer services and telecommunication services, from others). Table 5 outlines a classification of service industries into this tripartite system, noting some of the anomalous and borderline cases that arise.

82. Before elaborating on this approach, it is useful to note that the classification refers to the *core* operations of the industries involved. All industries tend to have a range of *peripheral* activities which service their core activities -- for example, most sectors employ office workers, transport staff, etc. These may be the basis for specific service firms in their own right. These activities are discussed in chapter III of this study, devoted to the examination of the trajectories of technological change in different services sectors.

83. This approach does provide insights as to the innovation process in services. It may be safe to say that service sector activities have been less amenable to mechanization and automation than the activities of manufacturing and primary sectors. Historically, the technologies that were responsible for most progress in other sectors of the economy -- such as cheap motor power, new chemical processes, electronics and mainframe computers -- have had limited impact on services. Major technological developments such as motor transport did, of course, have applications within services; but they were typically less pervasive in their applications across services as they were in manufacturing. Earlier generations of IT did, however, find substantial application in certain services. Mainframe computers have long been used for large-scale "back-office" administrative ac-

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20 This draws upon the discussions of Hill (1977) and Riddle (1986), and is an approach elaborated in Miles (1987a, b). A similar tripartite classification is used by Illeris (1985).

Table 5

A tripartite categorisation of service functions

Service functions	Industries/branches	Activities/occupations
Physical services	Transport and storage Wholesale trade Retail trade Repair and maintenance Postal services Domestic services [a] Laundry and dry cleaning Eating and drinking places [a] Engineering and architectural services (some) Misc. business services (some: e.g. office cleaning)	Transport Stores Repairs Maintenance Cleaning Catering
Human services	Medical and health [a] Hospitals [b] Education [c] Barber and beauty services Misc. personal services (some) Entertainment and recreation services (some) [a c]	Doctors Paramedics Teachers Training
Information services	Telecommunication Engineering and architectural services (some) [a] Entertainment and recreation services (some) [a b] Misc. business services (some: e.g. computer software) Banking, insurance and finance Accounting and bookkeeping Legal services Government	Clerical Secretarial Managerial Information Personnel Accountants Lawyers Civil service Researchers

a High human service component in addition to classification.

b High physical service component in addition to classification.

c High information service component in addition to classification.

tivities in services (e.g. banks and government) as they were for other sectors -- but they were too expensive to apply to many "front-office" tasks.

84. New IT brings the role of technology in services into much sharper focus. It enables cheap and rapid information-processing to be made available in "front-office" locations in effectively all services, since cheaper, simpler, less bulky, and less time-consuming facilities are available. Earlier, electronics was restricted to standardized data-processing or communications traffic, and thus mainly applied in administration, large-scale process industries, and some information services such as broadcasting and telecommunications. New IT is applicable across the economy, to both large-and small-scale operations.

85. Diffusion of IT is happening rapidly across services in industrialized countries -- albeit from a generally low base. While some services are adopting innovations from the IT-producing sectors of the economy, others are themselves becoming major sources of innovation. Telecommunications service providers supply innovations to the whole economy. Software production is a major activity in many service firms. More advanced firms are also well along in designing many aspects of their IT hardware (namely banks' automated teller machines (ATMs)).

86. However, IT has been applied very unevenly across services. A very sketchy picture can be provided in terms of the three classes of service activity noted above. IT was applied early to information services -- telecommunications, broadcasting, finance, etc. which were hugely dependent on electronics, and adopted new microelectronics-based IT on a large scale. The information functions of other services have been fertile bases for IT application, but their core physical and human functions were not very suitable for IT application. More and more, the decreasing costs and increasing power of new IT have made it possible to apply computers and data communications to these services' core functions, a development that looks fairly unstoppable. New techno-economic paradigms may be forged across the services sector in the coming decades. The following sections of this report examine the use of IT in the different types of service activity, and highlight the issues that these raise for trade and technology transfer.

Chapter III

TECHNOLOGICAL CHANGE IN SELECTED SERVICE INDUSTRIES

A. Office and related service activities

87. This section focuses especially on office work. Office work is a service activity that is carried out on a large scale in practically all branches of industrial activities, and itself may form a distinct tradeable service industry. However, other services are also carried out in many sectors, even if on a typically more limited scale. Among these services are:

- Cleaning, repair and maintenance work for premises and equipment;
- Safety and security work;
- Catering;
- Sales work and other relations with suppliers and clients.

88. Many of these activities are often carried out as services internal to an organization, or as main functions of specialized producer service firms. Some general features of the application of IT to such activities, which form peripheral functions of many service and manufacturing industries should also be noted. In particular:

- *Relationships with clients* can be mediated through new IT-based systems. For instance, conventional notices and displays can be supplemented by electronic displays; to telephone enquiries may be added viewdata and other computerized enquiry systems; booking of tickets and the like may similarly be mediated by ticket machines or online booking systems (teleservices).
- *Exchange* may be carried out through "cashless" transactions (use of credit cards and "smart cards"); the purchase of tickets, etc. may be handled through online systems.
- Where the service involves equipment or property, functions such as maintenance, security, and emergency warnings may be mediated through IT systems (autodiagnostics, remote monitoring, security systems, etc.).
- *Hospitality and courtesy* functions may be provided through technological means: for instance, the provision of audio or television entertainment options in waiting rooms, on flights, etc. These facilities may be used for promoting corporate image and products as well as to enable clients to relax or enjoy time spent waiting for service delivery.

89. This section will focus on office activities; subsequent sections will deal with some other physical and information services. These discussions contain material relevant to the application of IT to related peripheral services within other sectors.

1. Office Work

(a) Types of office and office work

90. Office work in all sectors is involved with managing, co-ordinating, and designing the core production functions of the sectors, and the peripheral activities necessary for these to continue to operate. Offices record activities and store records; they often manage relationships between suppliers to the industry and the industry itself, as well as relations with clients; they organize the wages of the workforce and the administration of personnel relations; offices are the site of at least

some of the work of drawing up blueprints and designs for new products and new organization of production. Since these are information-intensive activities, it is not surprising that there is much scope for application of IT -- just as in the information services discussed below.

91. Offices vary, of course, and in part this variety reflects the specific activities of different sectors. However, there are also some types of office and office work that are quite commonly encountered, for instance:

- Specialized head offices -- which are often at distinct sites (usually in capital cities) in large multi-site organizations in which senior management formulate overall strategy, and make key daily decisions;
- Branch offices, from which middle managers service senior managers' information needs and implement their strategies; and in which lower management monitors specific activities (to assure that targets are being met, for example) and keep higher managerial levels informed of developments (preparing data in suitable forms for presentation to these levels);
- Secretarial offices, providing personal assistance to managers, with support in the form of typing or word-processing of texts, handling telephone and mail enquiries, filing records, photocopying, etc.
- Clerical offices (e.g. typing pools), in which clerical workers provide essentially impersonal services to managers, similar to the classes of activity in secretarial offices but often of a more routine form and executed through a high division of labour;
- Specialized information centres, such as libraries, data processing centres, etc.

92. IT finds applications in all these types of office. It is possible to classify particular types of office activity and associate these with current technological developments. Table 6 sets out one approach here. Many of these emerging or already-familiar systems involve the use of IT to relax the constraints that have traditionally made IT labour-intensive and led to its being widely regarded as showing little productivity growth. These constraints are similar to those of many other service activities: they have been time- and space-bound. Thus, in the traditional office, a telephone call had to be answered directly, a dictation session required simultaneous presence of both parties, etc. Data storage (answering machines, voice storage, message storage in electronic mail systems, dictation machines) and telecommunications (fax, electronic mail, etc.) make it possible to transmit documents around the world hundreds of thousands of times faster than conventional mail and courier services and hence they have relieved these constraints, meaning that office work can be "distributed" over space and time in new ways.

93. This has made possible new spatial divisions of labour in office work. Data entry (from handwritten texts, ticket stubs, or audio tapes) can be carried out over great distances from the point at which the material was first produced. Likewise, interaction with customers and other callers can take place over great distances through telecommunications networks. These potentials are being grasped by firms eager to minimize wage costs (clerical work is often very expensive in capital cities), and also, sometimes, to make it possible to service managers and clients outside of conventional office hours (e.g., by using workers in other time zones). Despite forecasts of a great increase in "telework" (office work being carried out in homes rather than in conventional offices, which has been promoted as saving firms office overhead costs and saving workers travel costs), the development of such work organization remains limited. In contrast, the development of regional and "offshore office services" (dealt with in more detail later in this study) was notable in the 1980s.

94. Nevertheless, much office work in large firms remains in their head offices, with location as an important determinant of the spatial division of office work. Head offices are developing internal information flows through the use of Management Information Systems (MIS). They are also increasingly using IT systems to transmit data to the firm's customers, suppliers, and its regional and local branches and sites. The key technologies here are often described by the catch-all term "networks": they involve voice and data communication systems (often involving packet-switching and digital telecommunications, sometimes operated by specialist suppliers rather than the national public telecommunications carrier); and they also involve particular sorts of service and software such as electronic data interchange, (EDI, a system for ordering and invoicing) and electronic mail.

95. While "telework" remains rare, *mobile communications* are leading to some change in the location of what was traditionally office work. New communications facilities in transport

Table 6

Technological change in office activities

Office functions	Technologies
External communications	*From:* external mail (postal services); telephony; telegraphy; telex; *Adding:* electronic mail; new telephone services (PBXs, messaging, etc); telefax; viewdata, teletext.
Internal communications	*From:* memo slips, telephony; *Adding:* electronic mail; new telephone services; electronic bulletin boards.
Data storate and retrieval	*From:* filing cabinets; libraries; microfiche; tape storage of (mainly numerical) data on mainframe computers for restricted access to large data files (payrolls, etc); press cutting services; *Adding:* storage of all forms of data (text, numbers, graphics; and now digitalised voice and video) on new media (hard and floppy discs, CD and videodisc) for distributed or local use by terminals and microcomputers, and accessed by user-friendly database management systems; online databases for news items, bibliographies, etc.
Information processing	*From:* calculators; statistical modelling on mainframes; systematic and intuitive use of human skills and intellectual techniques; *Adding:* the above plus an array of microcomputer-based techniques such as spreadsheets, 'idea processors', interactive graphical systems for data inspection, and 'expert systems' of various degrees of sophistication; overhead transparencies and slides.
Information presentation	*From:* typewriters and electronic typewriters; conventional printing; hand-drawn graphics (using transfers and other means of standardization); *Adding:* word-processing (eventually with direct voice input); desktop publishing; computer graphics derived from spreadsheets or graphics/CAD packages; videotapes; 'videoslides'.
Meetings	*From:* conventional meetings and conferences; *Adding:* plus telephone conferences; video-based tele-conferences; computer conferencing.
Activity management	*From:* diaries, wallcharts, secretaries' memories; *Adding:* diary programmes on PCs which act as alarms and reminders; programmes to help scheduling and task ordering.

Source: Based on Miles (1987b).

(in-train-and-plane phones as well as car phones) and hotels (IT business centres), together with new technologies (such as portable cellular telephones and laptop computers equipped with modems), make it possible for more frequent contact between worker and firm, without the necessity for physical presence or calls via conventional public telephones. Filling of the gaps in the telecommunications web in this way enables mobile workers to:

- Maintain contact with head office to improve scheduling;
- Keep up-to-date with office developments and messages;
- Directly interrogate firm databases (for example, in helping a client draw up an insurance form or a purchase order, or in order to obtain pharmaceutical or other medical data).

96. As large service firms of all types (and large organizations in other sectors) come to rely more heavily on networking and mobile communications systems, their activities are increasingly determined by the quality of the telecommunications infrastructure. The tariffs charged for conventional and advanced facilities, their availability in different locations, the time taken to install them, etc., are all important determinants of the activity of these firms. Their pace of innovation, their international competitiveness, their locational decisions, and many other features, can be influenced by the direction and pace of infrastructural development.

97. Some commentators argue that the emergence of new "techno-economic paradigms" (see chapter I) in office and other service work will be determined by such telecommunications factors. However, the nature of this new paradigm is debated. In contrast to some accounts of "flexible specialization" in manufacturing, some commentators have argued that although IT increases the relative advantage of small and medium-sized production units (at least in manufacturing industries), it also tends to support greater scale and centralization of R and D, design and marketing activities. Thus there may be a growth in the role of head offices in such activities. In contrast, the more routine roles may be relegated to other office sites, with further division of clerical labour.

98. A recent summary of studies of emerging trends in the location of office activities is provided by Illeris (1989). Drawing on studies in North America and Europe, the following points are made:

- Corporate head offices are most often located in big cities, "due to the high intensity of orientation contacts and face-to-face meetings conducted by the corporate top management and other strategic services" together with the availability of suitably skilled staff. (Illeris, 1989, pp. 108-109);
- Back offices (which perform routine clerical work and do not interface directly with clients) are frequently located on the peripheries of big cities, where staff with certain levels of technical skills and cheap premises are available;
- Research and development facilities vary considerably in terms of their centrality to corporate strategy, and in their degree of contact with head offices, educational establishments, etc., and accordingly vary in location -- in or close to big cities, in university towns or "high-tech" areas (e.g. Silicon Valley), etc.;
- Corporate computer services are also typically concentrated in big cities, although with data communications and the growth of computer service firms catering to a more dispersed user population, this may be weakening.

(b) Toward office automation

99. The above discussion has focused on the external relations of office work. But IT is also being used within offices, as indicated in table 6. A distinction is sometimes drawn here between two generations of IT application in offices: (a) office mechanization; and (b) office automation (OA). Office mechanization refers to the application of (generally stand-alone) devices in offices, usually with each device replacing some earlier mechanical or electronic device to carry out a specific task. Personal Computers (PCs), dedicated word processors (WPs), electronic typewriters, "smart" telephones and private branch exchanges (PBXs), and photocopiers are now widely diffused in Western countries, at least to large organizations.

100. Office mechanization has been associated with considerable change in daily office routines, but while large productivity gains were typically reported in early trials, in practice there has been less sign of major productivity increases in office work resulting from the introduction of these ITs. (Nevertheless, it would be a rare firm that would be prepared to go back to traditional office technologies.) Several factors seem to be at play here:

- Organizational change and learning is required to establish efficient ways of using new office technologies;
- New modes of work organization and new skill structures are required: often these involve changes in management work, which are frequently resisted;
- Instead of increasing efficiency, new technology is often used rather to increase product quality (e.g., in the case of texts, by more redrafting, more attention to presentation -- as in the emergence of desk-top publishing);
- Similarly, new technology is sometimes alleged to lead to "information overload" rather than to more efficient use of data (e.g. proliferation of inter-office memos);
- A rather different argument suggests that the important developments are unlikely to occur until the application of IT moves beyond the substitution of new technologies for existing devices, a more or less one-to-one replacement of office equipment, and toward the introduction of new systems which can be used to reorganize the process of office work as a whole, cutting through traditional divisions of labour and discrete activities.

101. OA is a further stage of development, beyond office mechanization, and appears in many respects to describe the emerging techno-economic paradigm for office services in all sectors. To date, however, OA-type systems have been taken up on a much more restricted scale than office mechanization. OA involves linking discrete devices, integrating them into office systems. Furthermore, OA involves linking together discrete items of office mechanization through Local Area Networks (LANs). In addition to network management equipment (cables, switches, etc.) a key device is the "office work-station". This refers to a PC (itself serving as word-processor, tool for analysis of quantitative data, and drawing board, among other things) linked directly to computer-communications systems such as viewdata and electronic mail, and (in advanced versions) using voice and video messaging systems.

102. OA systems blend together three types of office IT: First the distributed data processing system, providing multi-user access to a mainframe computer -- typically used for a small range of standard tasks, but providing little scope for horizontal data communications. Secondly, is the powerful desktop PC, bringing high-quality data analysis and presentation to managers with limited keyboard skills. Thirdly, is data communications within and between offices and sites. Advanced OA systems have been on offer from a number of manufacturers, and installed in large corporations since the early 1980s.

103. OA has evident advantages -- for instance, the same data need not be re-entered into each device through which it is to be processed -- but has proved difficult to achieve in practice. The move from office mechanization to OA has been impeded by such factors as:

- The costs of rewiring buildings and installing new equipment and software;
- The incompatibility of standards (for communication, text management, databases, etc.), which has made it difficult to integrate existing and planned systems;
- Fear of being "locked-in" to a particular supplier and to particular technical options, when open systems are only of limited availability;
- Slow response of some IT manufacturers to the requirements for networking (e.g. Local Area Networks);
- Organizational difficulties, e.g. conflicts over control of IT facilities, shortages of technical skills, and need to reorganize work in the light of new technical facilities.

104. A related development to OA is the "smart building". This term refers in its more restricted sense to a commercial building whose security and energy management functions are computerized. A more extended sense refers to an office building in which internal and external computer-communications facilities are used both for OA-type administrative activities and for maintenance of the office environment itself. A smart building will have computerized monitoring and control

of fire and other emergency alarm systems, lighting, heating and ventilation control, even "smart" lifts (responsive to voice instructions) and surveillance facilities (for intruder detection, access control, and monitoring employee time-keeping). OA functions such as advanced telephony, fax, electronic mail, messaging, WP, and access to mass data storage on shared computers, and to business online databases, are also among the range of functions provided.

2. Office services as a tradeable industrial sector

(a) Offshore office services

105. Many office services are being traded -- even research and development may be contracted out (e.g. some United States firms are reported to externalize R and D to Israeli laboratories). However, it is most common to find the routine elements of office work, i.e. clerical services, being externalized to specialized producer services. "Offshore office services" typically consist of routine clerical work, and may represent services carried out by (i) remote offices of a large corporation for internal purposes; (ii) remote offices of a transnational corporation which sells office services to a second party; (iii) offices belonging to an organization in the host country, selling services to parties overseas. Combinations of these modes also exist, for example a Jamaican service that is a joint venture between a United States financial services firm and a Jamaican firm.

106. Systematic evidence on trade in office services is scarce, and there is limited information on which to assess the preponderance of the different modes of organization identified above. Posthuma (1987) estimated that anywhere between 6,000 and 15,000 workers were employed worldwide in these activities in the mid-1980s, although press reports would suggest that the scale of activity has grown considerably in the last few years. She estimated that the largest concentration of activity was in Mexico, with around 25 services of type (a) and an indeterminate number of type (c) operating. Around 20 such office services were operating in the Caribbean; perhaps significantly, at least one of these had spun off from a type (a) operation into an independent producer service company.

107. Most of these office services offer keyboarding work, for example inputting:

- Magazine subscription details for market research firms;
- Ticket stub records for airlines;
- Questionnaire results for survey firms;
- Financial data for financial services firms;
- Competition data for magazines.

108. Other office services are recorded by Posthuma (1987), including proof-reading of manuals for publishers, and disk-to-disk conversion of computer data across different formats. To these may be added telephone answering services, such as directory enquiries (carried out in remote locations, including Northern Ireland in the United Kingdom for British Telecom) and insurance enquiries. (The latter service, in Ireland, is used by a United States insurance company, which is thus able to make use of differences in time zones to offer services to clients outside of office hours).

109. When the services are not time-urgent, conventional means of mail transport can be used -- *e.g. for carrying manuscripts, coupons, or floppy discs.* When they are time-urgent, electronic modes of transport are more likely. Information that has been entered can be transmitted in the form of machine-readable data; otherwise, material can be transmitted by facsimile or voice telephony, as appropriate.

110. The development of telecommunications facilities has increasingly meant that offshore services can be located practically anywhere. Increasingly, the determinants of location become language, keyboard and organizational skills. Conventional telecommunications network linkages by satellite or cable make data transfer practically instantaneous regardless of location, as long as the host country has the relevant facilities. Soon, Direct Broadcast Satellite (DBS) facilities, which are already being used for certain types of specialized data broadcasting and delivery, are liable to re-

duce the technical requirements for receiving data communications to a matter of small and cheap satellite dishes, together with decoding equipment.

(b) Technological change and office services

111. Several features of the general pattern of IT development are liable to support further development of the offshore office services just described:

- Continuing development of more powerful data communication infrastructure, with several different, competing means of data communication (therefore probably pushing prices down). Improved communications (for instance, faster and less error-prone transmission of computer data or facsimiles): in turn, this makes reliance on offshore services more viable for both smaller and larger volumes of data, with the former becoming more cost-efficient, the latter more timely.

- Continuing expansion of the use of IT to process information of many types (i.e. not just traditional administrative data, but also, for instance, client and market data) in organizations of all types, with growing recognition of the utility of keyboarding records of all kinds.

- The development of new types of information service product, such as online databases, creating greater demand for machine-readable text (and, quite probably, other sorts of data).

- Cheapening of terminals and PCs, and diffusion of keyboarding skills, making application of the technology more viable in potential host countries.

- Computerized methods for checking and correcting errors, which are liable to reduce requirements for linguistic and cognitive skills on the parts of clerical workers. (Already, for instance, one company is reported to be able to use keyboard operators with no understanding of the text they are working with, relying on a matching of the text produced by two separate workers to detect errors.)

112. These factors are liable to be supported by social trends in many (but not all) industrialized countries. This implies a relative scarcity and high price of clerical skills and thus more interest in cheaper alternative labour inputs. However, there are certain technological developments which, in the longer term, may act against the extension of these types of service. Indeed, they may well reduce requirements for clerical work altogether. They include:

- Increased use of keyboards instead of handwriting by managers and professional workers, reducing the need for texts to be transcribed;

- "Data capture" systems (e.g. small, portable terminals) used by data producers, for example opinion pollsters; these remove the need for subsequent keyboarding of interview answers, since the interviewers make an electronic record at the outset (such systems are now widely used in telephone interviewing);

- Optical character recognition systems, which can directly convert handwritten text and other records into computer data. At present such systems are rapidly decreasing in price (little more is required than an image digitiser -- such as may be used to "capture" pictures for desk-top publishing -- together with appropriate software); but they are typically restricted in the range of material they can work with (either the handwriting of a particular person or set of people, or very stylized letters);

- Speech recognition systems, which can directly convert dictation into computer data. These systems are also limited, typically requiring "training" to recognize specific individuals' speech (and that with a limited vocabulary), or to recognize only extremely restricted sets of sounds (e.g. the alphabet or numbers).

113. These technological developments in the long term seem bound to reduce the need for specialized keyboard workers. In the short term, however, the demand for such services is liable to increase, and it is extremely difficult to anticipate when the two trends will intersect, resulting in a declining demand. Clearly it will be important for policymakers and entrepreneurs concerned with establishing offshore office services to monitor these developments. Similarly, it will be important to monitor developments which may affect the detailed form of such services. For instance, trends in the use of different telecommunications media will need to be watched.

114. Likewise, moves towards "open systems" in applications software and in telecommunications networks are extremely important. To date, limited compatability of standards, and limited interconnectivity across systems have restricted the utility of some computer-communications facilities. In the face of difficulties to transmit messages across different electronic mail systems, membership in multiple systems has sometimes been necessary. (It has been reported that, in the case of Electronic Data Interchange, different proprietorial standards have even meant that users in such sectors as the automobile industry have been forced to install several different terminals on their desks to link into different firms!)[21]

115. Electronic mail services have often had difficulty in dealing with more than a limited set of characters (i.e. ASCII characters -- meaning no use of underlining, italics, different fonts, etc.) and with graphics: which has been a major factor in the late 1980s boom in facsimile transmission, which took many industry commentators by surprise. (Ten years ago, electronic mail had been forecast to replace fax, which was expected to be in decline by 1990.) As hardware and software firms have been seeking to establish standards which would make complex data "portable" across different systems -- so that, for instance, text produced on one word processing package on one type of computer would look the same on another package on another computer -- these constraints should be eased. Staying abreast of such developments may be important in retaining competitiveness in office services.

(c) Technology transfer and office services

116. Concerning technology transfer aspects and trade in office services, Posthuma (1987) is extremely sceptical of the notion that technical capabilities in IT are being built up in companies offering such services. (Her survey does not include computer software programming activities, which will be dealt with later.) She argues that the skills which are developed and used are mainly those of rote data entry -- simple keyboarding clerical skills. More advanced keyboard technology than was previously familiar may have been introduced, but relatively little expertise in its use is being established.

117. This is a persuasive account of what has been the dominant tendency associated with these services to date. However, there are certain counter-tendencies reported in Posthuma's study. For instance, she notes that some data entry jobs in offshore offices do require (relatively limited) decision-making competences and (relatively limited) understanding of the nature of the information being processed (e.g. the meaning of code numbers). Likewise she notes some encouragement of local programming and maintenance skills, though these are largely restricted to "trouble-shooting", with any substantial skill inputs coming from the parent company. Posthuma notes that host country policy makers may seek to expand the range of services offered, but suggests that these will represent horizontal diversification rather than a matter of "vertically" adding more sophisticated services to the mix. She sees users of these services as being mainly motivated by their assessment of costs, hence relocating to cheaper or less heavily regulated sites more or less at will.

118. Again, this is a persuasive view, but it could be misleading to overstate it. In opposition to forecasts that office technology would lead to large-scale deskilling of office workers, many studies have demonstrated that in practice there have been limits to the division of office labour and the development of office factories in industrialized societies -- except for the very routine types of data entry that have been at the leading edge of offshore office services to date. When the task involves non-routine elements -- for example, when letters vary considerably in structure and content, when desk-top publishing outputs are required, where subtle errors need correction, where flexibility is required of the operative -- then more understanding of the system is required. The technological developments that have supported the diffusion of basic offshore office services may make it possible to develop more sophisticated services. It is unlikely that secretarial services will join clerical services offshore, but higher-grade clerical tasks -- and some components of secretarial jobs -- may move in this direction.

119. The combination of high labour costs in industrialized societies, and abundant skills and telecommunications facilities in other parts of the world (sometimes in developing countries, sometimes in "peripheral" industrialized societies), is likely to promote considerable growth in basic offshore office services, but also some growth in more sophisticated services. Among these more sophisticated services one might expect to see a number of activities where telecommunications can

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21 Cf. Miles and Thomas (1990).

suffice to mediate contact between office worker and the user of the data -- for example, desk-top publishing, telephone interviewing and marketing, and some IT-based information services (programming, online databases). Attention should be paid to the experience of such countries as Singapore, which are attempting to develop into "information economies" in part by such a route.

120. Basic office services are unlikely to contribute a great deal to national technical capabilities, since they locate only a fragment of the information-processing work in the host country and develop only limited skills in consequence. Conditions under which local office companies and joint ventures can lead to an establishment of more sophisticated capabilities, and keep the country at the forefront of these continually evolving services, require serious investigation.

B. Construction services

1. Definitional issues

121. The construction industry requires inputs from a wide range of technical services. These vary in technological intensity but each is essential to the final realization of investment projects, whether they be new projects or extensions and renovations to existing sites. Technical services can be divided into engineering design, and construction services. The former include many information-type services; whereas the latter are primarily concerned with effecting physical transformations leading to the completion of the investment project.

122. Engineering design services can be further classified according to the stage of development of the construction project itself. Three categories of services can be defined -- pre-investment, project execution and project implementation. Table 7 lists the services included in each category. It should be noted, however, that the boundaries between categories are not hard and fast. Many of the services are technology intensive, and require the skills of engineers, economists, market and financial analysts. To an increasing extent, technical developments in computer-aided design (CAD) and also in project management software are changing the skill profiles of these professionals.

123. Construction services are those required for the physical construction of investment projects. They can be defined as that part of the construction industry which installs and maintains the mechanical and electrical systems in buildings, including heating, ventilating, air-conditioning, plumbing, electrical supply, communications and lighting. These also require specialized engineering and management skills, but also make extensive use of unskilled and semi-skilled labour. The remainder of this section focuses on construction services.

2. Trade in construction services

124. The construction industry generally is characterized by a highly variable size distribution: both very large and very small companies survive, particularly in a local market. Even in global markets, the wide variety of skills required in a single project means that large and small companies are often connected to each other via complex subcontracting arrangements. Construction projects have also historically required the presence of at least some members of the service supplier on site. To some extent, this presence can be reduced by the frequent use of telecommunication services.

125. Owing to the complex contractual arrangements, the high degree of movement of people, and the lack of standard classifications for these services, any measurement of trade flows is difficult. For example, the total value of a contract is likely to be attributed to the prime contractor, even if subcontractors are based in other countries. Another problem is that construction projects often last for several years, so it can be difficult to attribute appropriate values for single years.

Table 7

Classification of engineering design services

Pre-investment services:

- Opportunity studies;
- Screening of project ideas;
- Market studies;
- Technical requirement studies;
- Techno-economic feasibility studies;
- Technical evaluation of project;
- Economic and financial evaluation;
- Location studies;
- Evaluation of means of financing.

Project execution services:

- Process and product design;
- Production planning and scheduling;
- Architectural and structural design;
- Design and layout of machinery and equipment;
- Evaluation of bids;
- Supervision of construction and equipment installation;
- Purchasing, inspection and testing of materials and equipment;
- Quality control.

Project implementation:

- Production activities;
- Technical personnel training;
- Management personnel training.
- Maintenance

Source: Soubra, 1989, pp. 186-187.

Table 8

Market share of international construction (as measured by new contracts awarded to the top 250 international contractors)

(Billions of U.S. dollars, and per cent share in brackets) [a]

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
United States	48.3 (45)	48.8 (36)	44.9 (36)	29.4 (31)	30.1 (37)	28.2 (35)	22.6 (31)	18.1 (24)	25.9 (27)	38.4 (34)
France	8.1 (7)	12.1 (9)	11.4 (9)	10.0 (11)	5.4 (7)	6.7 (8)	7.1 (10)	8.6 (12)	11.1 (12)	13.2 (11.8)
Germany Fed.Rep.	8.6 (8)	9.9 (7)	9.5 (8)	5.4 (6)	4.8 (6)	5.4 (7)	5.5 (7)	5.9 (8)	8.1 (9)	8.6 (7.7)
Italy	6.2 (6)	9.3 (7)	7.8 (6)	7.2 (8)	7.8 (10)	8.7 (11)	7.4 (10)	9.2 (12)	13.3 (14)	10.8 (9.6)
United Kingdom	4.9 (5)	8.7 (6)	7.5 (6)	6.4 (7)	5.7 (7)	5.6 (7)	7.0 (9)	7.9 (11)	9.4 (10)	12.9 (11.4)
Other Europe	9.2 (8)	12.6 (9)	10.3 (8)	9.1 (10)	7.2 (9)	6.2 (8)	6.7 (9)	8.9 (12)	7.3 (8)	7.4 (6.6)
Japan	4.1 (4)	8.6 (6)	9.3 (8)	8.7 (9)	7.3 (9)	11.6 (14)	9.4 (13)	9.9 (13)	11.6 (12)	12.8 (11.2)
Korea Rep. of	9.5 (9)	13.9 (10)	13.8 (11)	10.4 (11)	6.8 (8)	4.8 (6)	2.6 (4)	2.1 (3)	1.4 (2)	- (-)
All other countries	9.4 (9)	10.5 (8)	8.6 (7)	7.0 (7)	5.9 (7)	4.4 (5)	5.6 (8)	3.3 (4)	6.0 (6)	8.5 (7.5)
Total	108.3	134.4	123.1	93.6	80.5	81.6	73.9	73.9	94.1	112.5

Source: *Engineering News Record*, various issues, McGraw-Hill Inc.

[a] Total does not correspond to the sum of components owing to rounding at component level.

Finally, contracts may also include the value of goods and materials as well as services, thus leading to an overestimate of the value of services traded. (Soubra, 1989, pp. 188-190). Table 8 provides data collected by the industry itself. It gives an impression of the magnitude of trade during the 1980s and the market share of the major countries. The share enjoyed by the United States has fallen from 45 per cent to 27 per cent. This has been picked up primarily by France, the United Kingdom, Italy and Japan. In a report prepared by the United States Office of Technology Assessment (1987), two major reasons are advanced to explain the decline in United States market share. One is that technologies for construction have become more homogenous, thus making price competition more intensive. A second is that the construction markets in Latin America and the Middle East have declined relative to those in Asia. This shift has particularly benefited Japanese companies in relation to United States companies.

3. Technological change in construction services

126. Gann (1989) identifies a number of features of the construction services industry which affect the process of technical development. The existence of so many small companies and construction projects that are often unique means that much R and D is very informal and takes place outside the industry. Change is a difficult, slow process because buildings are immobile, complex, durable, expensive and subject to extensive regulation to meet public safety requirements.

127. Unlike manufactured products, which can be transported from the point of production to the point of consumption, most buildings have to be produced on the site where they will remain. In the past, this has limited the extent to which productivity improvements could be achieved, as the site-specificity of the product and labour limited the possibility of using factory production techniques. But IT-related organizational changes, and developments in materials are all having an impact on the construction services industry.

128. Some of the major technical developments affecting construction services are listed below (compiled from Gann, 1989 and OTA, 1987):

- CADD (computer-aided design and drafting) can cut labour inputs by a factor of three or more;
- Interactive CADD, which automatically revises all drawings and updates materials requirements will result in further savings;
- Together with integrated databases, CADD systems can also be used in project scheduling, cost accounting and materials tracking;
- Computer-assisted engineering software can ease calculations for structural analysis, foundation design, etc.;
- Expert systems are being developed for optimizing welding parameters. Expert systems could be applied to many standard calculations;
- Site use of microcomputers, particularly if connected to head office, will reduce delays arising from changes in design or materials availability;
- Off-site prefabrication of components. This has been extended from standard materials such as tiles and beams, to include "pods", such as toilets, plant rooms, kitchens, elevators and laboratories. These can be constructed at a factory, transported, floated into position and then plugged into the trunk systems of water, gas and electricity.

129. Apart from prefabrication, the technical developments listed above have been facilitated by IT developments. Together with the desires of users of new building to hasten the construction process, thus reducing costs, these technical developments have opened up new organizational possibilities; changing skills profiles of engineers and draughtspeople and changing the pace and nature of communication flows between construction sites and design offices, for example. This is to be expected from the earlier discussion of the emergence of new techno-economic paradigms, requiring both technical and organizational changes.

130. The other major development affecting large construction projects is the emergence of "fast-track" techniques. The aim is to provide a more rapid capital turnover. This is primarily

achieved through overlapping design and construction, resulting in a "just-in-time" design method. The other key element is increasing use of prefabricated components which are installed as soon as they arrive on site, leading also to a just-in-time construction method. Technical changes in other sectors will also affect construction services indirectly. For example, in the chemicals industry, the move from commodity products toward high value-added speciality chemicals means that new plants will be smaller.

C. Computer services

1. Some salient features

131. As with telecommunications services (discussed below), computer services are in effect completely IT-dependent: telecommunications and computer services are both important ways whereby IT delivers information services. Computer services are particularly important in facilitating the diffusion of IT (e.g. computer training, maintenance, and consultancy), and in realizing its inherent programmability by producing software (software houses).

132. Both computer and telecommunications services are heavily influenced by continuing change in the core technologies. They are not autonomous service activities -- they both make intensive use of IT, and the demand for their products is a function of IT development. This clearly influences the scope for industrial development strategies in these branches. In the case of computer services, the development of new types of computer (minicomputers, microcomputers, etc., and more recently the development of parallel processing architectures) and of microprocessor (successive developments of "chips") has been particularly important.

133. The computer services industry, as distinct from computer manufacturing, was first dominated by data processing services, operated by computer offices. These offices offered use of their computer installations for large-scale "number-crunching" operations on behalf of firms which could not justify or afford purchase of expensive mainframes. Over the years, these offices have tended to be linked to users through telecommunications networks rather than, as at the outset, communicating via the physical transport of data on magnetic tape or disc. This phenomenon of data communications from terminals to remote mainframe computers accounts for many (but not all) Value Added Network Services (VANS) being statistically classified with computer services rather than telecommunications services. While VANS are a thriving new service industry, computer office-type services of the traditional kind have declined in relative terms as other computer services have developed as an independent industry.

134. Software houses have been the most dynamic activity within computer services. Software was originally supplied by hardware manufacturers, as an integral part of the computer package. Hardware manufacturers are still important suppliers of operating systems software, but increasingly applications development software tools, and both general-purpose and industry-specific applications software have become the focus of independent service firms. Software has been "unbundled" as a distinct but immaterial technology distinct from computer hardware. Although a strong element of customization exists in many computer services -- with software houses producing bespoke software or modifying standard software for specific users and with much software being developed in-house by users -- standard packaged software has become a major market, with considerable levels of trade.

2. Software

135. Software is particularly interesting as a tradeable activity for a number of reasons. First, it is a key element of computer use -- indeed, it is widely suggested that software costs are the dominant and growing element in the costs of IT systems overall, both for users and for suppliers of IT systems. (Within this, it is further suggested, the costs of maintenance of software have been

coming to dominate the costs of initial production.) Secondly, it is a form of technology that is extremely difficult for producers to appropriate, with considerable volumes of piracy and illict copying of code. Thirdly, as reflected in its relative costs, software production is a labour-intensive (and still in large part a craft-like) activity. Fourth, related to the above points, software is often regarded as one of the few IT activities where there are substantial chances for entry into production on the part of developing countries: indeed, it is sometimes suggested that those countries with a surplus of skilled low-wage labour could have a particular comparative advantage in software production.

136. There are certainly cases of "peripheral" countries producing software for industrialized country markets -- India and Hungary for Western Europe, several South East Asian countries for Japan. There are also cases of countries developing indigenous software industries behind protective barriers of one sort or another. However, Gaio (1989), in an analysis of the technological trajectories of software and the implications posed by new techno-economic paradigms in software production and use for developing countries, suggests that this potential is quite problematic. She shows that the development of software activities has been critically influenced by developments in hardware -- especially, in recent years, in microprocessor technology. She also discusses the intense efforts being made to turn software into an engineering discipline, reliant more on standard tools and techniques than on intuition and craft skill.[22]

137. As noted, software activity has increasingly concentrated on packaged software, which is an important element in IT trade: software is being internationalized.[23] The majority of internationally traded software emerges from the United States, reflecting, as Gaio notes, a variety of entry barriers that operate in this sector. United States firms have "complementary assets" such as early access to knowledge of hardware developments and to the requirements of both advanced users and the large base of IT systems of all levels in the United States. They have distribution networks and links to local maintenance and consultancy services. They are familiar with emergent standards and protected in terms of intellectual property rights; there are specialist suppliers in various niches of the software market; and so on. These factors do not rule out the possibility of new entrants: but they demonstrate that it is insufficient to conclude that entry will be easy with simply a low-wage, technically skilled workforce.

138. While software requirements often vary in detail according to the specific user requirements -- and in the early phases of computer use it was common for software (even operating systems, in some cases) to be prepared on a bespoke basis -- there has been a shift to the use of software packages. Several factors motivate the use of packaged software.[24] These include:

- Lowered costs of packaged software as the diffusion of computer systems with standard operating systems and protocols has made it possible to realize economies of scale. (These are particularly large, owing to the minimal costs of reproducing software.);

- Widespread frustration with cost and development time over-runs on the part of software houses: in contrast, packages can be purchased at known prices, usually at short notice (though there are also difficulties associated with the late availability of new releases of favoured software);

- Skill shortages: it is often difficult to obtain software development skills when required, and the loss of key workers may set back project development by substantial periods. Often it has proved safer to invest in packaged software that only performs a fraction of the tasks desired rather than embark on a high-risk strategy of developing the "perfect" program;

- Availability of manuals, documentation and user-friendly features: established software packages have typically evolved to such a point that they can be relatively easily learned by their target users; suppliers can afford to produce extensive documentation, tutorials, etc. In contrast, in-house software is often poorly documented, as developers are called to new tasks;

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22 It is important to stress that interest in software engineering is not simply a desire to reduce software writing costs. It is also increasingly important that software be well-structured and documented, so that it may be revised and developed as necessary over its life-span. Many critical applications are locked-in to software which is now poorly understood and hard to debug or maintain.

23 For detailed documentation, see OECD (1989).

24 See, for instance, Brady (1989), OTA (1987).

- Upgrade paths and integration: often software packages are "future-proofed", with promises as to the continued usefulness of current data with future releases of the package; often there has been an effort to provide a measure of interworking with other standard packages, so that data can be moved across applications.

139. However, as several commentators note, there seems to be a distinctive Japanese model of software industry development, which is far less reliant on packaged software than the European and United States models. Considerable effort is being made in Japan, as elsewhere, to develop Software Engineering (SE) methodologies. This is particularly marked on account of a shortage of skilled labour in Japan; Gaio (1989) suggests that (i) export of software writing to South Asian countries is limited owing to the need for close user-producer interaction in advanced IT applications; and (ii) the relatively centralized economic and institutional framework is more conducive to the diffusion of advanced SE techniques than are the looser systems of other industrialized countries.

140. Important current and emerging technological developments affecting software include:

Hardware developments

- New architectures for microprocessor units: this includes "chips" of continually growing complexity, Reduced Instruction Set Chips (RISC) architectures, and devices with novel designs such as three-dimensional chips, optical chips, etc.;
- New philosophies of computing, providing alternatives to von Neumann architectures (based on sequential processing of different steps of computational operations), most notably parallel processing systems;
- Innovative approaches to applications development, some spanning hardware and software techniques, such as neural network systems (with the capacity to "learn" operating procedures in complex environments);
- Distributed computer systems, with many personal computers (PCs) and work-stations linked in data communications networks.

Software engineering developments

- Fourth Generation Languages (4GLs) which support powerful applications and themselves have powerful interfaces and more natural-language-like features;
- The development of Software Engineering (SE) techniques and tools for applications development, together with libraries of commonly used routines. Among these systems are Computer Aided Software Engineering (CASE), Integrated Programming Support Environments (IPSE), and others;
- "Shells" for the development of expert systems and similar applications -- and increasing importance of Artificial Intelligence-type applications;
- A "software tool industry" may be emerging within the software sector, and be particularly important in determining the patterns of software development.

Other software developments

- Non-proprietary "open systems architectures" and standard high-level languages enabling transport of applications across computers of different sorts;
- Efforts to make systems more user-friendly, and to develop "intuitive" interfaces such as Window/Icon/Mouse/Pull-down Menu (WIMP) and related methods;
- Growing demand for applications-specific software as IT systems continue to diffuse into new applications.

3. Software trade and development

141. Gaio (1989) notes a complex set of costs and benefits confronting developing countries considering developing software industries. She notes that there are some opportunities for "catch-up" and "leap-frogging" on the part of newly industrializing countries, in part made possible by the slow developing of new techno-economic paradigms around IT production and use in industrialized countries. The benefits of indigenous software development may include:

- Employment;
- Development of skills and technological capabilities (affecting future purchasing as well as production, and benefiting the whole national IT industry as well as software only);
- Import-substitution possibilities;
- Potential for matching applications software more closely to local requirements (this may involve modifications of imported software as well as programs developed from scratch).

142. But there are costs and risks in aiming for such goals by these means, namely:

- The complexity of the institutional framework required;
- The high costs of R and D;
- Possible delays in IT availability and diffusion;
- Potential dissipation of skills needed to promote sophisticated IT use;
- Isolation from at least some parts of the software and hardware technological frontiers;
- Retaliation against measures perceived as protectionist or as violating intellectual property rights (IPRs).

143. The scope for successful software strategies needs to be set within the context of national systems of innovation (see section A.3 of chapter I). Technological capacities need to be established by a variety of methods (formal training, reverse engineering and -- because of the links to basic science -- higher education and use of advanced searching methods such as use of computer networks). Particular attention has to be paid to developments in the hardware and software industries worldwide -- for example, the development of new standards and chips.

144. While software is highly susceptible to reverse engineering, the integrated nature of hardware and software in many IT applications, and the close ties between software writing and subsequent computer services (including software maintenance), may make this less useful as a way of building up technological capabilities -- and may make technology transfer agreements in software rather hard to define and enforce.

4. Other computer services

145. A range of other activities is also classified as computer services, including some consultancy and training services, facilities management, and repair and maintenance of hardware and software. (VANS are treated as telecommunication services in the next section, even though they are sometimes statistically aggregated with computer services.) Software maintenance activities are believed to contribute a large and growing proportion of software costs, and are influenced by the developments cited above. Traditionally they were in-house activities, or supplied by bespoke consumer service companies, but this is probably being eroded by a shift to packaged software, with efforts to provide "upgrade paths" allowing users to keep up with successive improvements of software.

146. Computer services directly connected with hardware -- maintenance and installation, etc. -- have been influenced by the shift to physically smaller, microelectronic-based systems. Maintenance has tended to become a matter of replacement of modules, since the core electronics cannot be repaired by technicians. Auto-diagnostics are incorporated into many computers, sometimes directly communicating with the computer manufacturer or services company. The level of skills

required by installers and maintainers has correspondingly declined, but continuing diffusion of IT to less expert users has meant that these computer service staff require more understanding of the requirements of end-users.

5. Software and technology transfer

147. Software is a peculiar commodity, simultaneously immaterial yet a vital intermediate good underpinning the operation of computer and other IT systems. As it is typically easy to reproduce and hard for its producers to appropriate, intellectual property rights have been much disputed in this domain.

148. The production of software has often been portrayed as an activity particularly suitable for developing countries with a technically trained workforce, as it is labour-intensive, (allegedly) subject to slow rates of technical change, and represents a continuously growing market. Several developing countries have gained a foothold in software trade, even though the world market is very largely dominated by United States packages.[25]

149. It is important to recognize that there are several distinct kinds of software. Software may be oriented to devices of particular sorts (e.g. from supercomputers to microcomputers). It may be applied to functions ranging from operating systems, tools for developing applications, general-purpose applications, and industry-specific applications. It can be marketed as a package (i.e. like a standard commodity), distributed in the public domain (or as "shareware"), or produced on a bespoke basis for users by hardware suppliers or, more often software houses or in-house systems development staff.

150. Software is essentially a matter of instructions that operate hardware -- ranging from computers to machine tools, from telecommunications switches to avionic systems. Yet, within the computer world in particular, software is partly independent of specific items of hardware, in that efforts are made to make software transportable across different systems: the move toward greater portability of software (e.g. writing it in high-level languages, using common standards and protocols for database structures, etc.) is extremely important, but far from complete, and continually challenged by the development of new applications and proprietory systems. Software is often said to lag behind hardware development, since users are frequently reluctant to risk obviating skills and data that have been accumulated using a particular software system; programming languages developed decades ago are being used on new generations of microprocessor.

151. Nevertheless, programming languages are evolving. There are efforts to create open systems as common platforms across different brands of hardware. Software practice can suffer "shocks" as new hardware generations pose new requirements (for example, parallel programming demands different styles of software; and new generations of microprocessor, and new architectures such as RISC chips also lead to changes in optimal software).

152. Several developing countries -- typically large and/or newly industrializing countries with substantial technical resources are making a mark on the world software scene, despite the dominance of United States exporters. Gaio (1990) notes that the Brazilian software industry has managed to achieve significant exports: for example, one firm signed licence agreements with China, Cuba and the USSR. Government policy has targetted the development of operating systems as a priority area. Gaio argues that this means breaking into a relatively mature sector of the market -- one which demands considerable skills and closeness to hardware producers. The export agreement cited above was facilitated by the restrictions on United States exports to these countries: in most areas, the United States is clearly dominating world software trade.

153. Gaio reports that applications software has actually provided most opportunities for Brazilian producers in local markets -- but it has not created sufficient externalities to promote a dynamic local industry. She goes on to note that in the early stages of IT diffusion in a country, cross-industry software packages will predominate, and these are likely to be available relatively cheaply on the world market. Only as experience with IT grows is a substantial local market for industry- and firm-specific software likely to arise, and stimulate development of a local software industry. Such a second wave of IT diffusion is now evolving in the newly industrializing countries.

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[25] Gahan (1990) presents a well-documented account of software from a developing country perspective.

154. Gaio describes four different "noninstitutionalized mechanisms of technology transfer" in software, each with its own characteristics:

Literal copy

- This can involve illict reproduction, often combined with the translation of user interface messages into local languages. It involves little learning as to how the program works: all that is required are skills to scan the program for commands and to modify them. Where relevant copyright legislation protects software, reproduction can be prosecuted as copyright infringement. Unauthorized copies of this sort are common among microcomputer users, who often argue that software costs are excessive, and/or that immaterial products should not be governed by the property relationships characteristic of other commodities.

Tropicalization

- Here the product is disguised, by being converted into different programming languages, relocating the location of commands, etc. While requiring more skill, this can still be a largely mechanical task, since it requires no substantive knowledge of the logical structure of the program. (Indeed, there are programs available which automate the conversion of codes from one programming language to another.)

Modification

- This means adapting the program so that in certain respects it operates in new ways, presumably more closely tailored to user requirements (for example, adding new functions, increasing the number of cases that it can deal with, etc.). This involves some reverse engineering; studying the program structure can lead to the amassing of useful tips about programming (though these will be unsystematic). It can lead to serious problems (the introduction of new "bugs") if programs are poorly understood. With larger, less mature, less well-structured programs, it becomes a highly skilled and time-consuming job. Maintenance of software may well mean modification to cope with changing user requirements (or to integrate it with changes in other parts of the IT environment); in Brazil modification emerges as an important source of learning-by-doing and learning-by-using.

Functional substitution

- This involves the writing of a completely new program to achieve more or less the same functionality as the original product (typically there will be some adaptation to perceived user requirements). It is similar to traditional reverse engineering, and requires skills in understanding the logical structure of the program and (to a lesser extent) in systems analysis and design. The popularity of such an approach to software production in the industrially advanced countries has led to new efforts at intellectual property protection, with the so-called "look and feel" legal suits appearing alongside more conventional disputes over property (i.e. ownership of lines of code and of algorithms). However, although at the time of writing the "look and feel" principle appears to be established, it remains highly controversial; and it mainly applies to features of the user interface (i.e. whether one software product resembles another from the user's point of view -- not whether it delivers the same functionality but looks different in terms of screen layout, etc.). Thus functional substitution will often not be liable to copyright concerns; and it can be a way of developing some of the skills of an advanced software service sector.[26]

155. In the Brazilian case, Gaio reports that all forms of non-institutionalized technology transfer have occurred, but to very unequal extents. Strategies such as modification and tropicalization are common: Gaio argues that functional substitution is a more productive strategy for developing local technical capabilities, and one which is liable to be more acceptable in a changing copyright regime. Imported software dominates the Brazilian scene, with local activity concentrating on applications. Government support for the development of applications packages appears to have been an important policy instrument, but support for development of software engineering skills (to advance upon the craft-like nature of production) was seen as a necessity for

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26 Based in large part on Gaio, 1990, pp. 248-253, passim.

future progress. Marketing and distribution capacities would be needed if local products were to compete in world markets.

156. The Indian software sector makes an interesting contrast to that of Brazil. In India, the supply of software services to transnational companies has been an important development. In one respect, however, the analysis of Srivastava (1989) parallels that of Gaio. He concludes that while the profit margins for successful packages are higher than they are for professional software services (e.g. writing bespoke programs, maintenance), India has little prospect of breaking into the world software package market. The obstacles here are the low diffusion of IT in India, shortages of venture capital, communications bottlenecks, and the associated problems of establishing marketing and distribution systems (especially for small firms).

157. One of the main factors facilitating Indian software development has been that country's high reserves of (English-speaking) technically-trained staff. Government has recognized the potential of the software sector for exports, and has encouraged the formation of courses to train more software professionals (for whom local demand is expected to grow).

158. India, or rather certain regions within that country (two firms in Bombay and Bangalore are dominant), has managed to become an exporter of professional software services to Europe and, especially, the United States; further efforts are being made to enter East Asian markets. Overall software exports, according to Srivastava, increased tenfold in value in the first half of the 1980s (and this dramatic rate of growth was expected to continue). Some 25 Indian software houses were registered as software exporters with overseas branches. Historically, this has largely involved the movement of software staff to work on-site at client organizations (Srivastava suggests that this has involved 80 per cent of the work). Such labour movements allow for the close association between supplier and user that is required for bespoke production of software. However, labour mobility is fraught with difficulties such as delays in issuing visas and work permits (and, perhaps, brain-drain problems -- government restrictions have been put in place to limit "body-shopping" of Indian professionals by United States firms, who have been recruiting within India as well as from Indian staff based overseas). This helps account for the growing interest in using satellite linkages to substitute information flows for movement of personnel.

159. Some major overseas firms are now commissioning work to be carried out in Indian data processing centres. For instance, Rao (1989) reports that Texas Instruments has set up a facility in Bangalore where 35 United States-trained Indian engineers work for United States clients via satellite links; DEC has a similar arrangement with the Indian firm Hinitroan; in Bombay, Citicorp Overseas Software produces systems for the parent bank. Hewlett-Packard is also reported to be planning to set up a software export facility. The move toward "software engineering" using structured programming techniques and a high division of labour might be seen as creating the possibility of a global assembly line in software, with local producers working on isolated fragments of the programming tasks rather than maintaining high levels of understanding of the overall program structure. While the present arrangements do seem conducive to establishing high technical capabilities in the software field in India, nevertheless, there is some concern about long-term problems associated with future staff shortages, and the relatively low investment in R and D among most Indian software companies.

160. Finally, Singapore, though a small economy, has also set about becoming an international software centre, as part of its goal of becoming a model "information society". The public sector will be the major instrument in achieving this goal. Its size and tradition of central co-ordination of economic development activities have made it possible to take dramatic steps into the information age.

161. Hardware manufacturing locally is dominated by transnational corporations, and national policy has been to target local production of software and information services. This has involved major training and education programmes (including overseas placements of graduates for advanced training), recruitment of senior professionals from abroad, adjustment of salary scales to stimulate recruitment into software activities in public agencies, management awareness programmes, and carefully phased introduction of new systems so as to minimize risk and facilitate staff and organizational learning.

162. Public agencies have been seen in Singapore as major customers for the domestic software industry, and as demonstrators for the whole economy as to the application of IT to service functions. According to Gilbert (1990) the key factor has been building organizational structures, with steady management commitment and skill, which can implement, continue to develop and maintain IT systems. This approach is far more complex than simply acquiring the hardware. The

national software effort has contributed to other Singaporean service activities -- finance, telecommunications and trade -- and more recently has been rewarded in the form of transnational software R and D activities being located on the island. Computer services are now exported from Singapore, especially to other public administrations engaged in computerization and network development.

163. While the software field is vital, it is difficult to enter -- and perhaps will be increasingly competitive. Thus, it is possible that competition from Eastern European producers will prove a substantial challenge to developing country suppliers of software service in the 1990s. Hungary, in particular, has been developing strategies for the export of professional software services (and even some packages for the low-price but high-volume home computer games market). The range of IT applications which demand software is continuing to grow explosively, but many of these applications may be rather remote from the immediate requirements of developing country industry.[27]

164. Some developing countries have successfully moved into software trade. There may well be scope for further activity in this sphere, although the market is not an easy one to break into. In particular, it requires:

- High technical skills in systems analysis and software engineering;
- Access to hardware (and preferably links with leading computer hardware manufacturers), and knowledge about hardware and software trends;
- Linkages with users and potential users of products, with telecommunications linkages emerging as an important complement to standard modes of personnel movement, attendance at trade fairs, etc.;
- Marketing and distribution skills.

165. These requirements take time and money to establish, and may involve changes in established orientations to, for instance, overseas training or the import of hardware. There is likely to be scope for technical co-operation among developing countries, with exchanges of information and staff, and co-operation in marketing.

D. Telecommunication services

1. Definitional issues

166. Hardware and software developments not only facilitate the delivery of familiar and long-established telecommunication services, they can create possibilities for the development of new services based on the processing, transmission and delivery of information. In order to reflect this, telecommunication services are defined here as including *both* network and telematic services.

167. ***Network services*** include both *public telephone networks* and basic telephony services, and more *specialized networks for data communications.* The latter includes:

- Private networks operated within organizations;
- Third party networks run by the class of VANS supplier;
- Networks known as Managed Data Network Services (MDNS); and,
- Facilities offered by public telecommunications operators for private use.

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[27] It may be interesting to note that an Indian software house is writing an advanced timetabling system for the London underground; and even application areas such as pattern recognition and other such articifical intelligence techniques are being seriously considered for applications in developing countries.

168. ***Telematic services*** (or interactive services), usually regarded as VANS, can be classified into three broad groups:

- *Communication or messaging services*, such as electronic mail, computer-conferencing;
- *Transactional services*, such as Electronic Data Interchange, and teleshopping; and,
- *Information-access services*, including online databases.

As noted in paragraphs 143 and 144, these services are often classified as computer services.

2. Technical developments affecting telecommunication services

169. Owing to their heavy reliance on network infrastructure, switching systems and customer premises equipment, telecommunication services are strongly influenced by developments in microelectronics and optical technologies, and by associated innovations in computer software design. Dramatic increases in the capacity of the hardware and software used in telecommunication have enabled the development, or planned development, of many new facilities. A highly compressed selection of developments in network infrastructure and in the services it carries is provided below:

(a) Network infrastructure

- Local Area Networks in buildings and sites, with increasing capacity (e.g. optical fibre-based systems), and increasingly linked together via private networks, or linked into public network systems;
- Digital Switching Systems which reduce the size and labour requirements of telephone exchanges, and which can allow for a variety of new customer services. Digital customer equipment (e.g. PBXs) is now diffusing. Optical Switching Systems (OSS) with a vast capacity are under development;
- Integrated Services Digital Networks (ISDN) with greater capacity than traditional networks, permitting various new and improved telecommunications facilities such as integration of text, voice and data communications, advanced forwarding and messaging systems, advanced videotex. ISDN is planned for introduction in most industrialized countries by the end of the century;
- The "Intelligent Network", which manages telecommunications through data base systems and programmable switches, allowing for many new ways of organizing communications (e.g. "portable" numbers, call diversion, etc.);
- Broadband communication networks, permitting high-volume data communication, including video signals as in cable TV and video-conferencing. These are still mainly experimental, with plans for widespread introduction remaining undefined; although optical cable (the main transmission medium) is increasingly used for trunk lines;
- New mobile communication services, such as cellular telephony, CT2 ("zonephones", "telepoint") and the anticipated personal communications networks;
- Data broadcasting: the use of broadcasting facilities as a way of distributing text and other data around business users (e.g. price data to retail stores) and, to a growing extent, consumers (Radio Data Services such as traffic information for motorists, etc.);
- Satellites are already used as a medium for long-distance network communications. Satellite Business Services, as in satellite "broadcasting" of electronic mail and satellite business services (specialized video and teletext, etc.).

(b) Network-based services

- New data and text communication services: electronic mail, videotex, computer-conferencing, Electronic Data Interchange (invoicing, ordering, etc.). One of the main issues here is the nature of the standards used to permit computers to be linked together, with Open Systems Interconnection supported by many countries and firms as an open architecture;
- Improved human-machine interfaces for such services, and exploitation of the processing power of microcomputers as remote terminals;
- New voice communication services: voice messaging, Centrex (allowing use of the telephone network as if it were a Private Branch Exchange);
- Video Communications. Freeze-frame and "slow" video can be transmitted by Picturephones on existing telephone lines; data compression allows some computer-assisted video transmission on ISDN (using PCs); advanced video conferencing systems are being reduced in price and their capacity enhanced, though these tend to require broadband networks;
- Optical character reading and scanning, enabling much quicker creation of databases to be used in the provision of telematic services. (This is in addition, of course, to the general increase in electronic processing of data of all kinds.)

170. As with software, future directions in telecommunication services will be greatly affected by hardware developments in transmission media, switching equipment and customer premise equipment. Telecommunication services are affected in turn by software developments (see paragraphs 139-142). It is increasingly recognized that software is often a major bottleneck to the achievement of the potential of telecommunications systems.

3. Telecommunication services, trade and development

171. Telecommunication services, unlike many physical and human services, do not require service providers to be located close to users. While this feature does reduce the volume of foreign direct investment, it can also make it difficult to gain access to the relevant hardware and software skills, although it may be relatively straightforward to gain access to the services themselves. Telecommunication services, and the infrastructure needed to provide them, have long been recognized as essential to the development process. It is partly for this reason that their provision has been state-owned and/or heavily regulated. Historically, there have been other reasons for this, including:

- Their important public service dimension. State intervention has been seen to be necessary to ensure equitable distribution of services: in particular, access to basic telephony services in peripheral regions, and the supply of public telephone booths. (However, it is noteworthy that fewer concerns about universal service have been expressed -- to date -- with respect to a number of new services.);
- Telecommunications services are strategically important to a country: failure of such services can cripple national industry and Government; failures in network security can be almost as debilitating;
- Telecommunications services have been seen as meeting most if not all of the criteria of being a natural monopoly. High entry costs, economies of scale and tight interlinkages have all contributed to strengthening the position of the monopoly supplier. (However, substantial criticism of the assumption of natural monopolies has been emerging, with the cheapening of network provision, and with the increased scope for competition between different modes of delivery of telecommunications -- e.g. satellite, cable, cellular links, etc.);
- Services have been largely undifferentiated, making it more difficult to support competitive suppliers. (However, the explosion of new types of services -- signalled in the creation of the label "Value-Added Network Services" -- has led to a wide range of new types of service provider entering the scene, under a variety of institutional arrangements in different countries.)

172. The public service and strategic dimensions remain important, though possibly being redefined to include only "basic" telephony. However, the natural monopoly and undifferentiated ser-

vice arguments are becoming increasingly difficult to sustain as a result of the technical developments described above. Liberalization pressures have been growing, both in the field of service provision and in that of procurement and supply of telecommunications equipment (which has traditionally been very much a matter of national champions supplying a national telecommunications supplier).

173. Finally, what are the options for new entrants in telecommunications services, and for developing countries to play more of a role in this area of services trade than simply that of importers? This question has received relatively little attention as compared to, say, generation of software services. In some ways, it is a particularly difficult question to answer, since the pace of change in telecommunications technology is such that it is not easy to foresee the scope for new types of activity. (To take only one example, a recent proposal is that it should be possible to reduce substantially the cost of satellite communications -- and thus to change the trade-offs between satellite and cable as a means of reaching remote areas or covering large territories -- by using large numbers of very small "smart" satellites instead of large geostationary ones.)

174. However, a few answers may be attempted. First, it may be unrealistic for most developing countries (and also many developed countries) to attempt to enter the market for provision of telecommunication *network* services. One challenge will be more that of coping with overseas competitors, who are liable to be pressed upon national economies (especially as more industrialized countries liberalize their systems), and which are liable to use more alternatives to traditional telephone network systems than previously. There may be scope for regional consortia offering "bundles" of network services, although this model could involve dominance of a regional "superpower" and its national champions (which might ultimately lead to higher costs and poorer service). Another challenge is that of maintaining access to international network systems. As Bressand (1989) argues, it is important for developing countries to be full players in the emerging trade environment.

175. Secondly, there may be a potential for utilizing and developing new *telematic* services, especially communication and information-access services. Access issues are important: online information services form one way of obtaining scientific and technical information to help the process of research and technology transfer in other sectors of the economy. There are also possibilities for developing information and communication services that serve the particular needs of the sector, country or region. IT services can be a support to national and regional technological capacities: indeed, often this is more likely to provide a market than would attempts to service high-tech users in industrialized countries.[28] Data bases of local expertise, computer-conferences that allow for the posing and answering of questions, specialist bibliographic services, and the like do not necessarily require extensive investment. It could even be argued that, just as there has been an "appropriate technology" movement, there is a need to move towards "appropriate information services".

4. Telecommunications and technology transfer

176. The telecommunications sector is highly strategic for national development, and has traditionally been organized by public monopolies -- the posts and telecommunications organizations or public telephone operators (PTOs). Equipment supply has often been targeted as an area for import-substitution policies, with a limited number of national suppliers developing very close relationships with the PTOs.[29] It has been common for PTOs to initiate joint manufacturing ventures with equipment suppliers, and to perform substantial amounts of R and D in-house (often specifying designs and technologies to the suppliers).

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[28] There is some discussion of certain developing countries specializing in "offshore telematic services" along the lines of office services -- or, that in the same way as tax havens and offshore banking facilities provide alternatives to national financial regulations, so there may be scope for "data havens" to evade national data protection laws. It is hard to see such possibilities as remaining open for long, however. And while the location of telematics facilities is effectively open, there are probably a variety of social and economic factors that will lead to these continuing to concentrate in core regions (Cf. Howells, 1989).

[29] Equipment supply has been the topic of some studies of technology transfer: in contrast, there has been little attention to technology transfer in telecommunications services. The interesting UNESCO study of *Technology Transfer and Communication* (Handcock, 1984) deals mainly with broadcasting media.

177. This trend has been changing in many industrialized countries, as a wave of re-regulation has swept telecommunications. Equipment supply is being liberalized in many countries, and has become a highly competitive area of international trade. Some of the newer telecommunications services are also being liberalized, with new operators often being allowed to enter markets for mobile communications services, Value Added Network Services, and the like. In several countries competition is encouraged even in basic telephony.

178. Nevertheless, telecommunications services typically remain highly regulated, since network supply is usually oligopolistic, and is perceived as having both public good and national strategic aspects. For developing countries, the establishment and maintenance of an adequate telecommunications infrastructure is necessarily a major issue: provision is often inadequate in rural areas and remote regions. For many countries, close links between telecommunications services and the equipment supply branch is seen as important for industrial development strategies (although a number of newly industrializing countries have been considering competition to stimulate efficiency in the sector and to gain access to advanced technologies).

179. The shift to digital systems in telecommunications has been one of the factors that has led to the wave of telecommunications re-regulation in industrialized countries. It has facilitated the emergence of new telematics services, created entry opportunities for firms based in computer and computer services sectors (and elsewhere), and led to major changes in the prices of equipment and services. In terms of the current discussion, however, digitalization is particularly important for two reasons, as Hobday (1986, 1989) notes. First, it enables developing countries to skip generations of telecommunications equipment and to "leap-frog" into electronic equipment which is often cheaper, more powerful, robust, and flexible than the electromechanical systems it is replacing. Some of these newer technologies may be developed locally by newly industrializing countries -- e.g. Brazil manufactures switches, satellite dishes, etc. Secondly, while electro-mechanical telecommunications equipment has typically been vertically integrated in terms of production, market structure and the technology itself (one of the factors in the oligolopolistic structure of the industry), digital equipment is more readily divisible. It is modular in design, with scope for configuring networks from combinations of hardware (and software) building blocks. The manufacturing assembly task (once microprocessors are available -- these will often be imported, though some developing countries now have manufacturing capabilities) becomes simplified, with entry opportunities for developing countries -- although high and extensive software skills are required.

180. In many developing countries, local equipment manufacturing capabilities are weakly developed, however. Thus Hobday and Baba (1990) note that even in Thailand (which aims to become a newly industrializing country, and to introduce an Integrated Services Digital Network -- ISDN -- telecommunications system), the telephone organization of Thailand (responsible for all domestic local and long-distance telecommunications, and providing some data communications and facsimile services) devotes very few resources to R and D. It relies on outside sources of technology without encouraging the transnational suppliers to transfer production facilities or collaborate with local firms: major equipment suppliers such as NEC and Fujitsu have installed as well as supplied the equipment. Consultancies from overseas are brought in for assistance with planning and organization, and foreign firms are used to monitor and inspect telecommunications installations: Hobday and Baba relate increasing reliance on foreign expertise to aid donors tying aid and loans to specific projects -- usually from Japan, the major source of finance.

181. In contrast, they report that the smaller Communications Authority of Thailand (responsible for international telecommunications, some domestic services in remote areas, and some data communications, telex and facsimile services) has sought to develop in-house technology and design capabilities. Specialized engineering and software knowledge, it is argued, help in negotiation with outside suppliers and, especially, in adapting digital systems to local conditions. The Authority sponsors overseas study for graduate students and has established an R and D centre which has a mandate to monitor and act upon overseas technological developments. It is believed that this effort to develop technical capabilities will enable the Authority to compete with the larger administration -- and in turn, this competition may speed the diffusion of advanced telecommunications services.

182. Singapore Telecom has undertaken an even more ambitious digital telecommunications strategy -- leading to the world's first completed ISDN system. Interactive services such as videotex are being delivered to businesses and homes via terminals rented at a low cost; these are, for example, used for schoolchildren to carry out homework. Business use of telematics services is high: 27 per cent of establishments with more than 10 employees report using computer networking, and 14 per cent of computer users use database services supplied by the Registrar of

Companies (National Computer Board, 1990). These developments are a further part of Singapore's strategy to become an "information society", building upon its vital location in South East Asian trade and financial activities.[30] Part of the 1986 National Plan for Information Technology, in which steps to implement many proposals were specified, was the establishment of Tradenet, an Electronic Data Interchange system networking offices involved in foreign trade. Here there seems to be an explicit recognition of the contribution that telecommunications can make to economic development, the need to invest in R and D in the sector and the need to stimulate linkages between different IT activities (computers, telecommunications, telematics, software).

183. Brazilian telecommunications have been extensively discussed by Hobday (1986, 1989). A telecommunications research centre was set up, under the PTO in Brazil, by the Ministry of Communications in 1972: its accumulation of expertise helped in bargaining with transnational companies, which were encouraged to engage in local manufacturing and development. There is evidence that local development has become an element in transnationals' competition for contracts: a wide range of public and private telecommunications equipment, peripherals, and related IT products are manufactured in Brazil by subsidiaries. A strategy of network digitalization was decided upon in the mid-1970s, with recent exchange technology, supplied by Ericsson and NEC, constituting a "leap-frogging" effect in that the switches are in advance of those typical in industrialized societies. Telematics activities have grown as the network has been improved, with consequent benefits for business activities (data communications, data bases, telex, electronic mail, banking and financial networks, etc.).

184. The Brazilian Telecommunication Research Centre has set up a number of programmes in digital telecommunications R and D -- including the development of microprocessors, fibre optic systems, and satellite communications, and training of engineers, gaining experience in computer-aided design, programming, component development, etc. Collaborations were undertaken with private companies and university laboratories, and Hobday concludes that substantial diffusion of knowledge has been achieved. However, he argues that this diffusion has been contained within the telecommunications field, whereas it might have been expanded more generally over other areas of IT production and application. This problem has been attributed to rigid institutional divisions between telecommunications and informatics administrations in Brazil; Hobday notes that such a division, with the associated lack of co-operation and co-ordinated planning, is common in many developing countries.

185. Telecommunications is one of many candidates for technology transfer activities. It is one of considerable importance, providing services for the whole economy. Through it, skills which are widely useful may be developed. New developments in telecommunications are leading to pressures to set new strategies for these services. The concentration of purchasing power in PTOs means that the telecommunications sector is one where strategic choices can be exercised through plans for infrastructure development and through procurement policy. PTOs have often (but not always) accumulated considerable technological expertise: the challenge is often one of moving this into the digital era. International linkages between PTOs have historically been important in providing mechanisms for the flow of information about technical developments, standards, etc., and there is scope for co-operation among PTOs, especially within regions. (However, the increasingly commercial orientation of PTOs in industrialized countries may limit the free exchange of certain classes of information to a greater extent in the future.)

186. Liberalization of telecommunications, if pursued, needs to be accompanied by measures to encourage local R and D of a sort that PTOs have traditionally supported. Where such support has not been forthcoming, it needs stimulation: possibly through the formation of a telecommunications R and D centre and linkages with institutions of higher education (in both cases it is vital to ensure that these remain related to sectoral activities, rather than drifting into academic "ivory tower" orientations), and with more general IT policy institutions.

187. R and D, as Hobday and Baba (1990) argue, should not, in general, be aimed at technological independence in telecommunications -- a goal that few industrialized countries can now sustain. However, R and D can be a fruitful element of the technology transfer system, and can play a vital role in training electronics, telecommunications and software engineers. It should probably be oriented towards improving and adapting telecommunications equipment and system configurations so as to better fit local circumstances, and identifying components of the digital

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[30] There are other aspects of the geographical location: it has been reported that Australian companies are keeping some of their databases in Singapore so as to avoid falling subject to Australian "data protection legislation".

hardware and software which can be sourced locally. The opportunities for such activities on a national or regional level will vary considerably. The crucial importance of telecommunications means that these opportunities should be inspected carefully, even if there is little local equipment manufacturing or software capability.

Chapter IV

CONCLUDING REMARKS

A. Technology and international competition in services

188. From the discussions in the preceeding chapters, it appears that the fairly rapid technological change in different services sectors, particularly the increased diffusion of information technology, has profound implications for services trade and development.

189. As more services can be delivered via telecommunications, or incorporated at least in part as software, so their tradeability, and thus international competition in services, may grow. Some commentators forecast a proliferation of services and suppliers, with the "twilight of hierarchy", the disappearance of intermediaries, and the fragmentation of large organizations. Current performance generally suggests however that big actors -- for example, large financial companies -- will maintain dominance over their sectors, becoming global corporations. While economies of scale in production may become less important, increasing returns to capital earned from the concentration of information and control will continue to play a key role in determining patterns of competitive advantage.

190. Increased international competition in tradeable services may mean greater *international* concentration, alongside a reduction in *national* monopolies, as appears to be the case already in financial services and telecommunications. Foreign competition is liable to provoke more rapid change in services in many countries.[31]

191. Cost reductions, greater efficiency, enhanced services, and new bundles of services are likely to be adopted as ways of winning new customers. This may lead to some blurring of boundaries between different service activities. Regulatory issues arise, especially when the bundling-together of services reduces client choice, and when cross-ownership of different electronic media may open the door to abuses of power. Increased tradeability and internationalization of services also poses regulatory challenges in standards setting, not only with respect to the technical interconnection of networks, but also for data standards.

1. Skill and training requirements

192. The application of IT to services is liable to increase dramatically the requirements for technical skills within service organizations. Such technical skills (e.g., operation and maintenance of advanced IT hardware and software) are likely to be valued more highly -- and they may remain in short supply, and thus relatively inaccessible for smaller and poorer firms and countries. New types of skill combination are also likely to emerge and be in demand -- for instance, combinations of computer, telecommunication and media skills. (There is currently much discussion of "multi-skilling" and "hybrid" managers.) There are likely to be variable short-term requirements for specialists to assist with the installation of new equipment and to help as technologies move through the product cycle.

193. It is also widely argued that, with continual improvements in IT, extended periods of training and retraining will become much more common. Together with continued uncertainty about the evolution of markets, and greater variety in products and associated production processes, there appear to be growing demands that workers be flexible in terms of particular tasks and skills. Two policy points follow from this. First, training programmes may be important for developing competitive services. What is more, training programmes themselves will need to be

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31 See Enderwick (1989) for an overview of transnational corporations' service activities.

continuously revised: trainers themselves will have to undergo retraining. Secondly, the regional distribution of skills and producer services needs to be examined, along with the related training efforts. The development of such efforts requires attention to the threat of losing national talent through the brain drain.

2. Work organization within firms

194. Within organizations, the strategic centrality of different company operations is liable to change. For instance, in-house information services may be seen as profit centres if the data can be treated as a traded commodity; telecommunications network functions may become critical to rapid response to environmental change. More generally (and related to the discussion of skills above) it is likely that a range of service-type functions will continue to become more and more important in firms in all sectors. These functions are liable to be supported and augmented by the use of IT as discussed earlier. In some industrialized countries, they have been mainly supplied on an in-house basis within firms, but in most countries there has also been a substantial growth in producer services firms, supplying required devices to other firms. Sometimes these have been "spin-offs" from parent companies -- this has been the origin of many computer and telematics services firms, for example, which have become separate entities growing out of activities first conducted on an in-house basis for firms (or, for example, local Government).

195. Several policy implications again arise. First, there is the extent to which producer services and in-house business services are able to support national industries and services. Again, this aspect calls for attention to regional issues, and to the training of both generalists and specialists in the appropriate technical services. Secondly, given that telecommunications infrastructure is extremely important to the development and use of several IT-based services, the degree to which existing facilities enable or discourage activity should be examined. The extent to which competitive services are oriented towards internal or external markets should also be examined. Thirdly, the role for international producer service firms in the national economy is bound to be of considerable interest. Purchasing services from overseas can relieve local skill shortages, and with appropriate arrangements it may be used as a mechanism for technology transfer and the development of local technical capabilities. However, it can also lead to the inappropriate use of technical and organizational solutions imported from overseas models, and it can lock users in to particular suppliers and technological trajectories rather than expanding their horizons of choice. Support for firms dealing with alternative modes of service provision (in-house, local producer service, or international service supplier) is likely to be often valuable.

B. Technology transfer

196. The development of new types of services related to Information Technology (IT), and the transformation of traditional patterns of service production and delivery via application of the new technologies has a number of implications for technology transfer:

- First, some IT-based products are mature, some are much less well-established: it may be difficult to break into production of the mature products, where economies of scale are important and marketing and distribution channels have been consolidated. Breaking into new product areas, moreover, demands considerable foresight and high-level skills (typically requiring close co-ordination between government, education, research and business participants);

- Secondly, conventional reverse engineering may be very difficult with IT hardware, because of miniaturization and integration of components: it is possible to examine and reproduce microelectronics circuitry, but it is difficult. In contrast, software is usually easy to reproduce: this has led to growing efforts to enforce Intellectual Property Rights by legal means in this field, but opportunities for "reverse engineering" (or "learning-by-undoing") are often present;

- Thirdly, new types of skill and new skill combinations are often required for effective technology transfer: these often mean melding technical appreciation of IT systems and understanding of the specific applications to which it is being put;

- Fourthly, and related to the last point, new types of qualification and working practice are evolving: for instance, methods of software engineering are being developed (though there are several different trajectories of development here) to make the systems development task more transparent, to overcome labour bottlenecks and reliance on particular individuals, and to ease the tasks of maintenance, validation, and "debugging";

- Fifthly, service firms may find themselves intimately involved in the design of both hardware and software which are important for their own operation, and may also be vital to the whole economy. Thus, in Brazil, for example, banks have been responsible for computer manufacturing, design of automated teller machines, and a number of software activities.

C. Agenda for future research

197. The service industries have long been recognized as an under-researched set of activities. In the last decade, they have attracted increasing attention in Western industrialized countries, although even so there is considerable unevenness in interest. (For instance, most large-scale studies of IT use focus on manufacturing -- and on stand-alone, rather than network, technologies.)[32] There is also serious effort being made by the United Nations Statistical Office and other bodies towards the development of better services statistics. However, more work is clearly necessary, since technological and organizational change, and the growing importance of service activities, mean that many of the most important features of new services remain largely invisible.

198. Among the key areas for detailed research, the following may be underlined:

(a) There is a need to improve understanding of the ways in which new technology is affecting the tradeability of services and influencing corporate strategies. For several years, commentators have been specifying the scope for IT-based service trade, and citing a number of outstanding instances; there is rather little systematic information on the extent to which such opportunities are being realized, in which sectors and between which countries, and with what consequences for patterns of FDI versus other forms of service internationalization;

(b) The interdependence between services and other sectors of the economy is now beginning to be recognized, but it remains poorly understood and documented. At the most basic level, this requires more documentation of the role of services in development, and analysis of service policies (and of the implications of industry, technology, and investment policies);

(c) Furthermore, both sectoral and more general studies of relations between services and other sectors are required. These would include studies that use macroeconomic statistics (input-output and other approaches) and those that are focused more on firm-level interactions. Studies should be capable of addressing imbalances that may occur for particular sectors, classes of firms and, especially, regions. This will involve attention to (i) the contribution of producer services to other industries (including their contribution to other services); (ii) the extent to which services are dependent upon particular types of IT hardware and software; and (iii) which hardware capacities are required in order to develop dynamic IT-based services;

(d) This report has provided a broad account of the major IT developments applicable to major classes of service activity. However, considerably more detail as to specific developments in hardware and software -- and in relevant issues such as standards and skills -- is required for policy analysis. The types of "search strategy" required for national systems of innovation to identify key developments, and the institutions that can gather, organize and help operationalize information in local contexts, may be investigated by

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[32] See Miles *et al.* (1989).

analysis of more or less successful experiences in service development. It would be particularly useful to study those countries that have been trying to seize opportunities to "leap-frog" into IT services.

(e) The trade-offs in service trade require investigation. This will involve attention to the role of transnational corporations active in services; to the scope for economies of scale in service production; to opportunities for new entrants in services with high technological dependence; to the extent to which niche markets (and stable markets) are typical in new services; to infrastructure requirements; and to other topics discussed briefly in this study.

BIBLIOGRAPHY

E. S. Andersen and B. A. Lundvall, "Small National Systems of Innovation Facing Technological Revolutions" in C. Freeman and B.-A. Lundvall (eds.), *Small Countries Facing the Technological Revolution* (London, Pinter, 1988).

E. Arnold and K. Guy, "Policy Options for Promoting Growth through Information Technology" (Paris, OECD, 1989).

R. Barras, *Growth and Technical Change in the UK Service Sector*, (London, Technical Change Centre, 1984).

R. Barras, "Towards a Theory of Innovation in Services" *Research Policy*, vol. 15, No. 4 (1986) pp. 161-173.

R. Barras, "New Technologies and the New Services" *Futures*, vol. 18, No. 6 (1986) pp. 748-772.

R. Barras and J. Swann, *The Adoption and Impact of Information Technology in the UK Accountancy Profession* (London, Technical Change Centre, 1983).

R. M. Bell, "The Acquisition of Imported Technology for Industrial Development: Problems of Strategy and Management in the Arab Region" (Baghdad, UN, ESCWA, 1987).

R. M. Bell and D. Scott-Kemmis, "The Mythology of Learning-by-Doing in World War II Airframe and Ship Production", mimeo, (Falmer, Brighton, Science Policy Research Unit, 1990).

F. Beluzzi, *Benetton: Technological Innovation in a Traditional Sector*, Science Policy Research Unit Occasional Papers (Falmer, Brighton, Science Policy Research Unit, 1987).

P. Blackburn, R. Coombs and K. Green, *Technology, Economic Growth and the Labour Process* (London, Macmillan, 1986).

T. Brady, *Users as Producers: Software's Silent Majority*, CICT Working Papers (Falmer, Brighton, Science Policy Research Unit, 1989).

A. Bressand, "Access to networks and services trade: the Uruguay Round and beyond" in *Trade in Services: Sectoral Issues*, United Nations publication (UNCTAD/ITP/26) (1989).

R. Bulthuis, B. van Holst and G. R. de Wit, *The Service Sector and Technological Developments* (Rotterdam, Netherlands Economic Institute, 1985).

M. Castells, *The Informational City* (London, Cambridge University Press, 1990).

M. Chatterji (ed.), *Technology Transfer in the Developing Countries* (London, Macmillan, 1990).

D. A. Collier, "The Service Sector Revolution" *Long Range Planning*, vol. 16, No. 6, 1983, pp. 10-20.

G. Dosi et al., *Technical Change and Economic Theory* (London, Pinter, 1988).

J. H. Dunning, "Multinational enterprises and the growth of services" in *Services Industries Journal*, vol. 9, No. 1, pp. 5-39.

T. Elfring, *Service Sector Employment in Advanced Economies* (Aldershot, Avebury, 1988).

P. Enderwick (ed), *Multinational Service Firms* (London, Routledge, 1989).

G. Faulhaber, E. Noam and R. Tasley (eds.), *Services in Transition: the impact of information technology on the service sector* (Cambridge, Mass., Ballinger, 1986).

A. G. B. Fisher, *The Clash of Progress and Security* (London, Macmillan, 1935).

C. Freeman, "The Challenge of New Technologies" in OECD, *Interdependence and Co-operation in Tomorrow's World* (Paris, OECD, 1987).

C. Freeman, "Technology Gaps, International Trade and the Problems of Smaller and Less-Developed Economies" in C. Freeman and B.-A. Lundvall (eds.), *Small Countries Facing the Technological Revolution* (London, Pinter, 1988).

C. Freeman and B.-A. Lundvall (eds.), *Small Countries Facing the Technological Revolution* (London, Pinter, 1988).

V. Fuchs, *The Service Economy* (New York, National Bureau of Economic Research, 1968).

V. Fuchs, *Production and Productivity in the Service Industries* (New York, National Bureau of Economic Research, 1969).

F. J. Gaio, *The Development of Computer Software Capabilities in Developing Countries: a case study of Brazil*, D. Phil. thesis (Falmer, Brighton, Science Policy Research Unit, 1989).

D. Gann, *New Technology, Employment and Operative Skills in Building Services* (Falmer, Brighton, Science Policy Research Unit, 1989).

D. Gann, *The Building Services Sector: A Background Study of Recent Economic, Technical, Employment and Skill Trends*, report for the UK Science and Engineering Research Council Specially Promoted Programme in Construction Management (Falmer, Brighton, Science Policy Research Unit, 1987).

J. I. Gershuny and I. D. Miles, *The New Service Economy* (London, Frances Pinter, 1983).

O. Giarini (ed) *The Emerging Service Economy* (Oxford, Pergamon, 1987).

B. Guile and J. B. Quinn (eds.), *Technology in Services* (Washington, National Academy Press, 1989).

T. P. Hill, "On Goods and Services", *Review of Income and Wealth*, vol. 23 (1977) pp. 315-338.

J. Howells, *Economic, Technological and Locational Trends in European Services* (Aldershot, Avebury, 1988).

J. Howells and A. Green, *Technological Innovation, Structural Change and Location in UK Services* (Aldershot, Avebury, 1988).

S. Illeris, "Services and the New Economy: Implications for National and Regional Development" mimeo (Regional Studies Association, Irish Branch, 1985).

S. Illeris, *Services and Regions in Europe* (Aldershot, Averbury, 1989).

R. Kaplinsky, "Industrial and Intellectual Property Rights in the Uruguay Round and Beyond", *Journal of Development Studies*, vol. 25, No. 3 (April 1989) pp.373-400.

K. A. Koekkoek, "Trade in Service, the Developing Countries and the Uruguay Round", *World Economy*, vol. 11, No. 1 (March 1988) pp. 151-156.

I. Kravis, A. Heston and R. Sommers, *World Product and Income* (Baltimore, John Hopkins University Press, 1983).

H. P. Krolis, *Producer Services and Technological Change* (Delft, TNO Research Centre for Urban and Regional Planning, 1986).

S. Kuznets, *Modern Economic Growth* (New Haven, Yale University Press, 1972).

T. Levitt, "The Industrialisation of Service", *Harvard Business Review*, vol. 54, No. 5 (1976) pp. 63-74.

H. B. Malmgren, "Negotiating International Rules for Trade in Services", *World Economy*, vol. 8, No. 1 (March 1985) pp. 11-26.

N. Marshall et al., *Producer Services and Uneven Development* (Brighton, Wheatsheaf, 1988).

M. Mathews and I. Miles, "The statistical analysis of the information economy: why an accounting framework is needed", mimeo, (Paris, OECD, 1989).

J. Meyer-Stamer, "Unconventional technology transfer and high tech development in newly industrialized countries", in M. Chatterji (ed.), *Technology Transfer in the Developing Countries* (London, Macmillan, 1990).

I. Miles, *The Convergent Economy* (London and Brighton; Papers on Science, Technology and Public Policy; 1987).

I. Miles, "Information Technology and the Services Economy" in P. Zorkosky (ed.), *Oxford Surveys in Information Technology*, No. 4 (Oxford, Oxford University Press, 1987).

I. Miles, *Information Technology and Information Society* (London, Economic and Social Research Council, 1988).

I. Miles, "Services in the New Industrial Economy" in E. Holst, B. Preil and P. Ring (eds.) *Dienstleistungen - Neue Chancen für Wirtschaft und Gesellschaft* (Berlin, Vistas, 1989).

I. Miles and J. Gershuny, "The Social Economics of Information Technology" in M. Ferguson (ed.), *New Communications Technologies and the Public Interest* (London, Sage, 1986).

I. Miles, H. Rush, K. Turner and J. Bessant, *Information Horizons* (Aldershot, Edward Elgar, 1989).

I. Miles and G. Thomas, "The Development of New Telematics Services", *STI Review* (Paris, OECD, 1990).

R. Norman, *Service Management* (Chichester, John Wiley, 1984).

J. Nusbaumer, *Services in the Global Market* (Boston, Kluwer, 1987).

W. Ochel and M. Wegner, *Service Economies in Europe* (London, Pinter, 1987).

OECD, *Elements of a Conceptual Framework for Trade in Services* (Paris, OECD, 1987).

OECD, *The Internationalisation of Software and Computer Services*, ICCP, No. 17 (Paris, OECD, 1989).

OECD, *Information Technology and New Growth Opportunities*, ICCP, No. 19, (Paris, OECD, 1989).

Office of Technology Assessment, *International Competition in Services, Banking, Building, Software, Know-how...* (Washington, D.C., United States Government Printing Office, 1987).

C. Perez, "New Technologies and Development" in C. Freeman and B.-A. Lundvall (eds.), *Small Countries Facing the Technological Revolution* (London, Pinter, 1988).

G. R. Pipe, 1989, "Telecommunications services: considerations for developing countries in Uruguay Round Negotiations" in *Trade in Services: Sectoral Issues*, United Nations publication (UNCTAD/ITP/26) (1989).

A. Poon, *Information Technology and Innovation in International Tourism: Implications for the Caribbean Tourism Industry*, D. Phil. dissertation, University of Sussex (Falmer, Brighton, Science Policy Research Unit, 1987).

A. Posthuma, *The Internationalisation of Clerical Work: a study of Offshore Office Services in the Caribbean*, Occasional Paper No. 24. (Falmer, Brighton, Science Policy Research Unit, 1987).

J. B. Quinn, "Technology Adoption, the Service Industries" in R. Landau and N. Rosenberg (eds.), *The Positive Sum Strategy* (Washington, National Academy Press, 1986).

J. Rada, "Information Technology and Services" in O. Giarini (ed.) *The Emerging Service Economy* (Oxford, Pergamon, 1987).

A. Rajan, *New Technology and Employment in Insurance, Banking and Building Societies* (Falmer, Sussex, Institute of Manpower Studies, 1984).

A. Rajan and R. Pearson, *UK Occupation and Employment Trends to 1990* (London, Butterworths, 1986).

C. Richter, "Tourism Services" in O. Giarini (ed) *The Emerging Service Economy* (Oxford, Pergamon, 1987).

D. Riddle, *Service-Led Growth* (New York, Praeger, 1986).

S.S. Roach, *America's technology dilema: a profile of the information economy* (Morgan Stanley Special Economic Studies, 1987).

D. Roseman, "Towards a GATT Code on Trade in Telecommunications Equipment", *World Economy*, vol. 11, No. 1 (March 1988) pp. 135-50.

A. Sapir, "North-South Issues in Trade in Services", *World Economy*, vol. 8, No. 1 (March 1985) pp. 27-42.

R. M. Scheffler, "Information technology and the U.S. Health Care Industry: a new direction" in G. Faulhaber, E. Noam and R. Tasley (eds.), *Services in Transition: the impact of information technology on the service sector* (Cambridge, Mass., Ballinger, 1986).

R. K. Shelp, J. C. Stephenson, N. S. Truit and B. Wasow, *Service Industries and Economic Development* (New York, Praeger, 1984).

J. Singelmann, *From Agriculture to Services* (Beverly Hills, Sage, 1978).

F. W. Smith, "Air Cargo Transportation in the Next Economy" in B. Guile and J. B. Quinn (eds.), *Technology in Services* (Washington, National Academy Press, 1989).

Y. Soubra, "Construction and engineering design services: issues relevant to multilateral negotiations on trade in services" in *Trade in Services: Sectoral Issues*, United Nations publication (UNCTAD/ITP/26) (1989).

G. Sternlieb and J. W. Hughes, 1986, "Information Technology, Demographics and the Retail Response" in G. Faulhaber, E. Noam and R. Tasley (eds.), *Services in Transition: the impact of information technology on the service sector* (Cambridge, Mass., Ballinger, 1986).

J. Swann, *The Employment Effects of Microelectronics in the UK Service Sector* (London, Technical Change Centre, 1986).

D. R. E. Thomas, "Strategy is Different in Service Businesses" *Harvard Business Review*, vol. 56 (1978) pp. 158-165.

N. S. Truitt, "Mass Merchandising and Economic Development: a Sears Roebuck and Co. in Mexico and Peru" in R. K. Shelp, J. C. Stephenson, N. S. Truit and B. Wasow, *Service Industries and Economic Development* (New York, Praeger, 1984).

UNCTAD, *Trade in Services: Sectoral Issues*, New York, United Nations publication (UNCTAD/ITP/26) (1989).

S. Vandermerwe and M. Chadwick, "The Internationalisation of Services", *Service Industries Journal*, vol. 9, No. 1 (1989) pp. 79-93.

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Printed at United Nations, Geneva
GE.91-55775
October 1991 –3,110

United Nations publication